PRODUCT

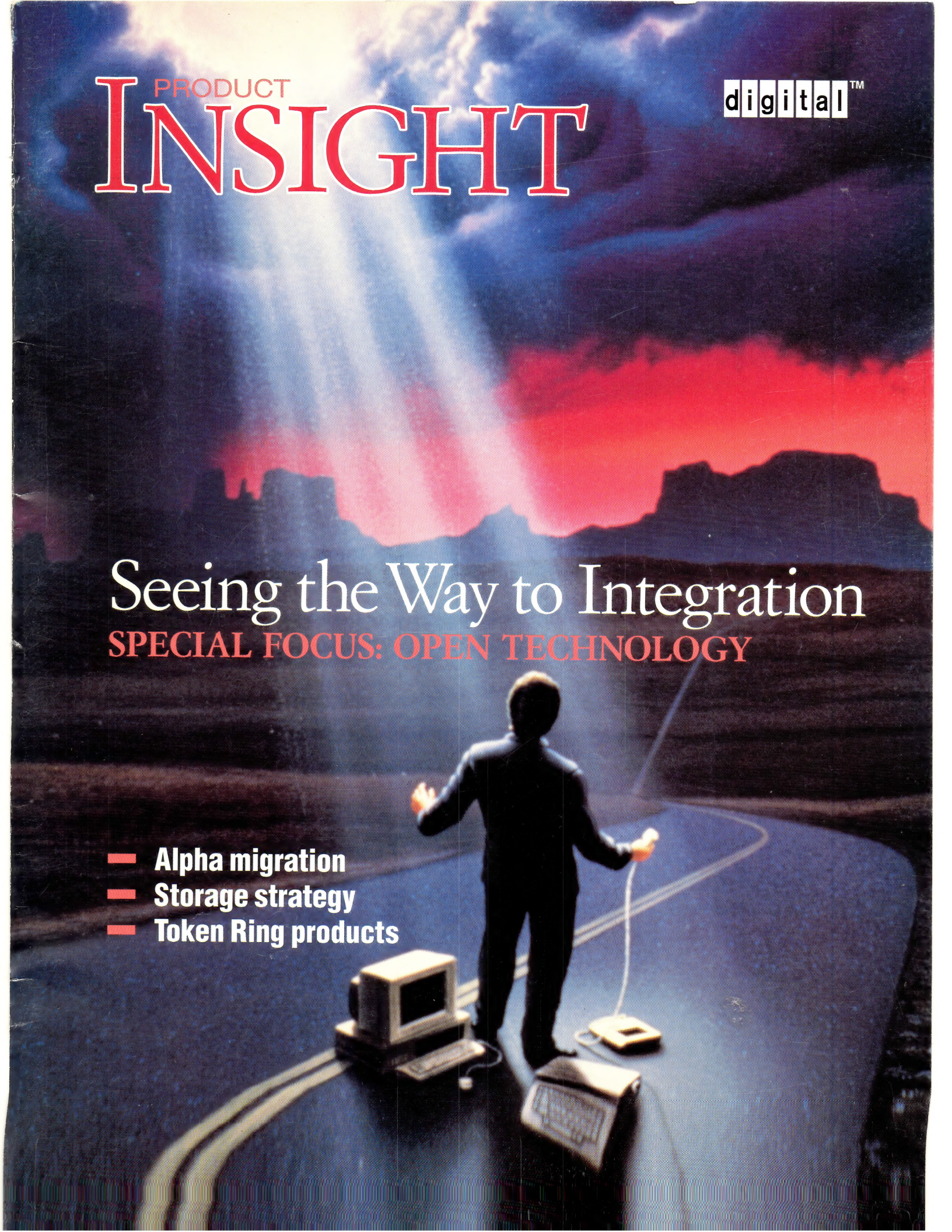
INSIGHT

digital™

Seeing the Way to Integration

SPECIAL FOCUS: OPEN TECHNOLOGY

- Alpha migration
- Storage strategy
- Token Ring products



PRODUCT INSIGHT

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Design: Janice Moore

Digital's vision of open technology was a big part of the recent DECWORLD '92 proceedings. Particularly impressive was an Innovation Center on the exhibit floor that investigated the idea of "information as a utility." It demonstrated how users can access, filter, and incorporate a wide variety of information from disparate sources as easily as turning on a light switch. Attendees that visited the Innovation Center viewed a variety of advanced development and future research efforts specifically aimed at dealing with the information challenges of the late '90s.

Identifying a Useful View of Open Technology

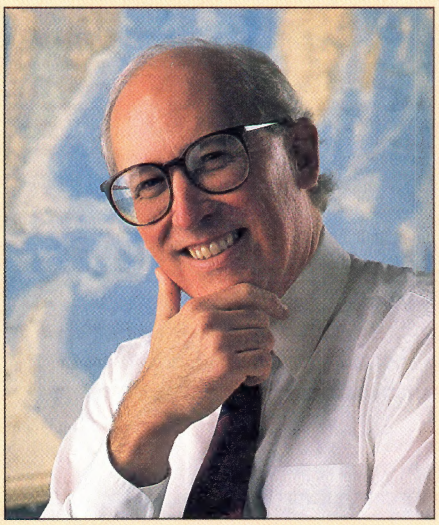


Photo: Walter Bibikow

Vice President Charles F. Christ is responsible for Digital's mass storage, departmental computing, and small-to-medium enterprise business. Prior to joining Digital in July 1990, he served as a partner in the Management Consulting Services group of Coopers & Lybrand, as president and CEO of Digital Sound Corporation, and had an array of positions at Xerox Corporation.

Active in many business, educational, and government organizations, Christ currently serves on the Board of Trustees of GMI Engineering and Management Institute and on the Board of Directors of Digital Germany GmbH. A graduate of the General Motors Institute with a B.S. degree, Christ also holds an M.B.A. degree from Harvard University.

We pride ourselves at Digital in developing high-quality products. Our recent introduction of the Alpha chip is a prime example. But we have also learned that technical wizardry is not enough.

Technology must complement your existing investments, you must be able to change it in response to changes in your business needs, and you should be able to choose the best products from multiple vendors and have it all work together. To do all of these things, information systems must also be open systems.

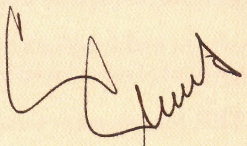
Investment optimization encompasses both people and computing resources. It involves your ability to make use of the existing expertise and training of your personnel, and to integrate existing information systems, data, and applications.

Flexibility enables you to pick the best solution for each aspect of a computing solution, whether it be a corporate database, a network to integrate various PCs, or a financial package for a single workstation. To be able to maximize your number of choices in the future, you should develop a unified software and systems architecture today. That does not mean standardizing on a single vendor or product line, but standardizing on interfaces that support the ability to "plug and play" multivendor systems and to access the same data. There are many standards organizations, such as IEEE and ANSI, that can provide guidelines.

Vendor independence may be a primary goal of your open systems strategy. You want to be able to choose among suppliers to keep your expenses down and keep quality at its highest. You want to be able to select from systems and applications that match your own specific requirements.

There are many ways in which Digital is implementing open technology: through the VMS and DEC OSF/1 operating systems, NAS middleware, and distributed applications to name a few...and our most current actions concerning the Alpha strategy. We are ensuring that you can take advantage of the new Alpha technology within an existing structure of VMS and UNIX systems as well as with a wide variety of multivendor desktop computers. We are paying careful attention to industry standards so you will be able to interconnect and interoperate Alpha-based systems with the industry's most popular systems and devices.

Pure technologists are happy just to invent, but at Digital, we find greater satisfaction in inventing the best technology to meet your needs. It's an Open Advantage we both can share.



Charles F. Christ

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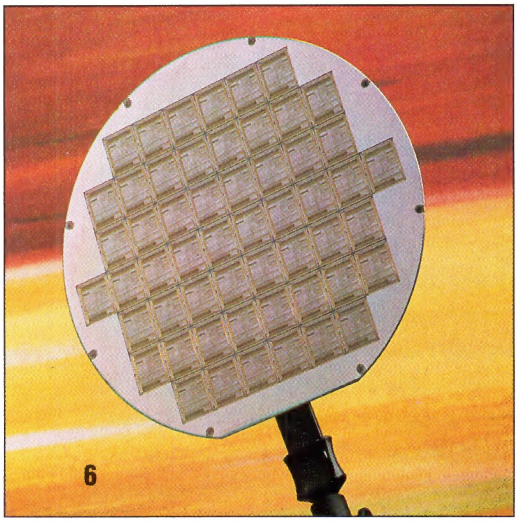

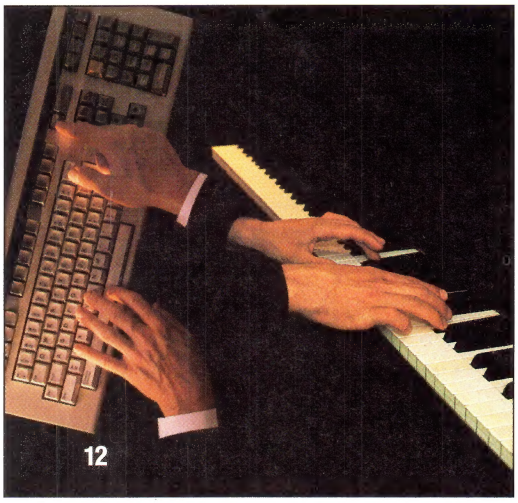

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4 Multivendor integration through a client/server architecture is shining through as the way to unify an organization's entire computing investment – past, present, and future.

Cover art: THE IMAGE BANK/Jerry Lofard

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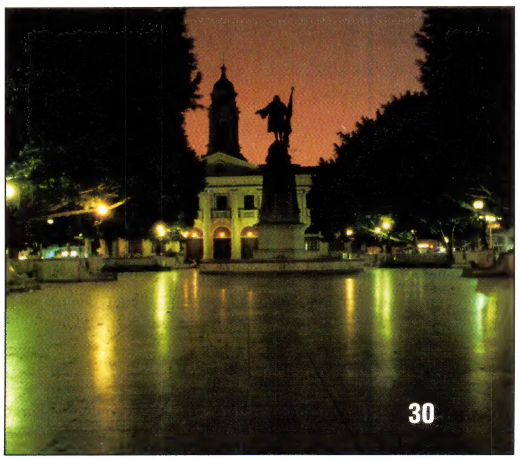


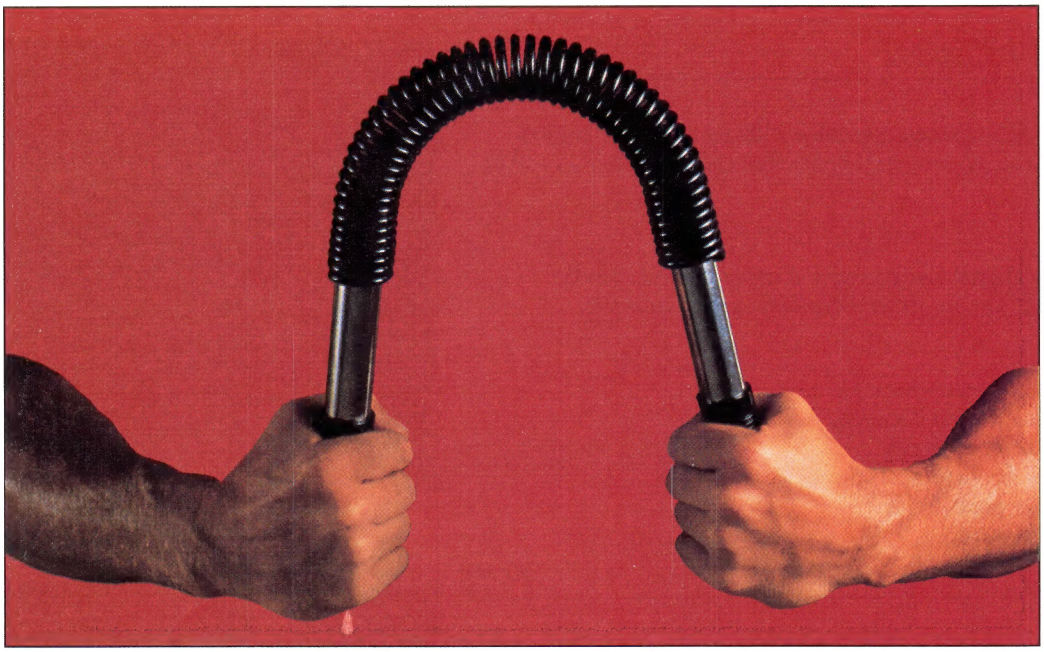


Photo: THE IMAGE BANK/Chuck Mason

Client/server architectures at many organizations are unifying multivendor configurations worldwide. This approach enables organizations to bend – not break – existing computing investments and power them with the latest technological advances. Digital's distributed computing and engineering strategies tie in nicely with client/server plans.

Technological Strength

OPEN DISTRIBUTED COMPUTING THAT WORKS

Does your organization have multiple departments, possibly in locations around the world? If so, you are probably experiencing the problems of having a diverse technology portfolio.

Since the advent of computing, various departments have purchased everything from mainframes to minicomputers, from storage farms to printer wheels. In the '80s in particular, as PC prices dropped, many groups went on buying binges and quickly diversified their system computing investments by putting lots of processing power from lots of vendors on lots of desktops.

To bring their resources together, many organizations are turning to client/server technology. This approach brings people and activities together by integrating existing investments together, rather than replacing or discarding them.

Over the last decade, Digital has followed a distributed strategy with its VAX architecture, instead of the more centralized architectures some other vendors chose. (See systems article on page 6 for more details on Digital's plans.)

Digital's distributed systems, scalable from desktop to data center, are by nature much easier to adapt to a client/server configuration than their more rigid, centralized counterparts. Furthermore, Digital continues to work very hard to attain all the key attributes of well-managed, centralized systems: security, reliability, availability, manageability, functionality, and performance. And Digital has built an architecture that can incorporate multivendor systems as well as its own products. (See related client/server article on page 14.)

Bringing together multivendor technology goes beyond the systems themselves to involve many interrelated factors: operating systems, middleware, networking and distributed management, and actual applications. Digital focuses on all of these areas and also can provide a full range of open services to keep multivendor configurations running efficiently and cost-effectively to meet your business needs.

Open Operating Systems Emerge

Digital's primary operating systems strategy has undergone a dramatic revision.

The VMS operating system is as open today as many UNIX operating systems in the industry. The implementation of standards such as POSIX and XPG3 increases the potential portability of applications as other vendors support them as well. In the past, the VMS operating system was closely tied solely to the VAX architecture, but now runs on RISC-based systems. (See VMS article on page 10 for details.)

Demonstrating its commitment to a unified UNIX operating system, Digital also recently introduced the DEC OSF/1 operating system. Based on source-code technology from the Open Software Foundation (OSF), it complies with all major UNIX

specifications. To preserve investments in Digital's first UNIX offering, the ULTRIX operating system, Digital is incorporating the features of today's product (V4.2a) into the next DEC OSF/1 release. (See page 9 for industry reactions to the DEC OSF/1 operating system.)

Finally, Digital listens to what *you* want in the operating system. For example, many user sites requested the ALL-IN-1 application for desktop computers, and Digital responded with PC and Macintosh support. Your input becomes more and more important as Digital reorganizes itself from an engineering- to marketing-driven company.

Looking Beyond Operating Systems

The computing world contains more than the VMS, UNIX, and PC operating systems. The development of NAS (Network Application Support) middleware has made it easier for other standards-compliant systems to work with Digital systems.

Middleware provides a standards-based layer between the operating system and application software. As operating systems were often married to a specific piece of hardware, functions – although common between platforms – were often reduced to use on a single platform.

NAS middleware is an industry leader, with over 2,700 applications running on it today. It is far ahead of competitive solutions: Sun's software supports 1,000 applications, IBM's SAA has 275 applications, and Hewlett-Packard's NewWave only numbers 100.

If you want to expand the number of portable applications at your organization, investigate standards. Digital even makes your search easier with three scalable packages of middleware that group associated features together into an integrated solution.

Integrating Multivendor Networks

If the highest form of flattery is imitation, than IBM just paid Digital a great compliment. Recently IBM announced a *new* way of networking: peer-to-peer communications. Digital has been an advocate of the peer-to-peer style ever since it introduced the Digital Network Architecture (DNA) 12 years ago.

Last July, Digital revamped DNA to make it a truly multivendor network architecture. (See the ADVANTAGE-NETWORKS article on page 12.) Today, Digital supports the most commonly used protocols in the industry and has emerged as the leading integrator of multivendor networks.

Digital is also advancing the development of capabilities that enable organizations to use the network to manage diverse systems. Standards for distributed network management are just being defined today, but Digital began development of its own products to address this area over two years ago. (See the POLYCENTER article on page 16.)

By getting a head start in distributed management, Digital's own work is now focused on providing guidance for standards work. For example, Digital submitted four of the six technologies selected for the OSF DCE (Open Software Foundation's Distributed Computing Environment).

In addition to embracing multivendor technology, Digital is opening its own technology to other vendors. Having sold over a million DECnet licenses, Digital extended the opportunity to other vendors to sell the license.

Addressing the User with Applications

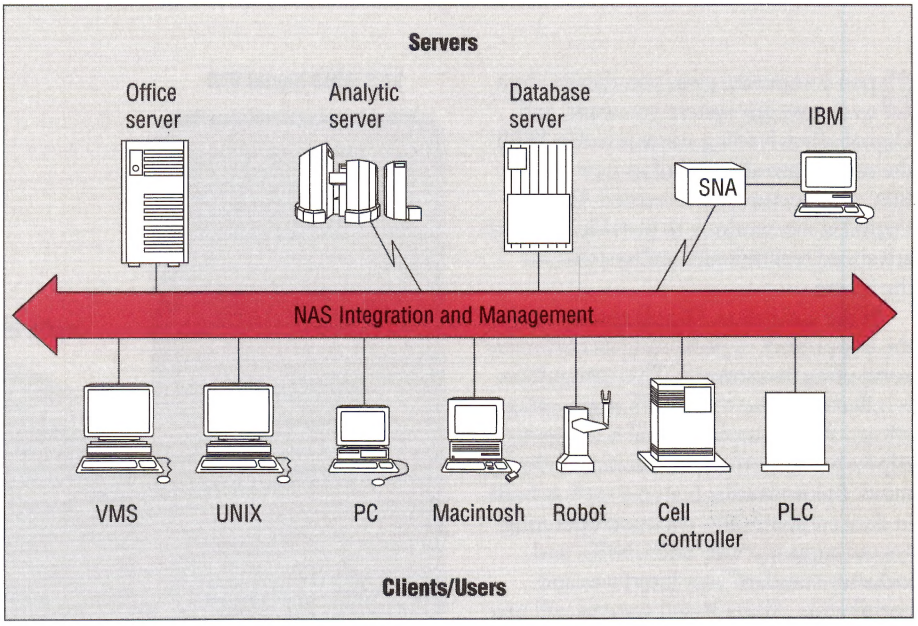
The ideal way to evaluate how successful you have been in unifying your diverse technology portfolio is whether or not applications *look* and *behave* the same to users, no matter what the underlying components are and where they are located.

Until industry standards govern every aspect of how computers and applications act, an application will never seem exactly the same on every platform. Nonetheless, by paying attention to industry standards and purchasing technology accordingly, you can come pretty close to application integration and interoperability today.

Digital concentrates on providing the majority of any computing solution with base components, products, and services. It relies heavily on Complementary Solutions Organizations (CSO) agreements with other vendors to provide the appropriate and specific industry application. Nonetheless, Digital has identified four critical applications areas that apply to multiple industries in which it is investing in heavily: office, transaction processing, computer-aided logistics support (CALS), and computer-aided software engineering (CASE). (See related article on page 18.)

Making a diverse computing portfolio work as a single configuration may be the greatest challenge you face in the '90s. But it's comforting to know that Digital's technology strategy today is addressing this very issue.

Digital Integrates Multivendor Systems Today



Choose the Best System and Protect Your Investments

Open computing gives you the freedom to choose any system you want, and Digital offers leading systems today. With the recent introduction of its new 64-bit RISC architecture, code-named Alpha, Digital is also working to provide the most advanced technologies and systems for the future.

At the same time, Digital recognizes the importance of protecting its customers' computing investments. This recognition is reflected in the company's engineering efforts. For example, Digital is designing Alpha-based systems with compatibility in mind. Incorporating features such as built-in data compatibility, common operating system support (VMS and UNIX), and industry-standard user interfaces and peripherals, Alpha-based systems will protect and enhance – not replace – existing computing capabilities for organizations.

For companies that may not require the capabilities that Alpha will provide, Digital will continue to extend its VAX and DECsystem families. These enhancements will enable VAX and DECsystem computers to meet the business needs of tomorrow – alone, in coexistence with Alpha, or in a multivendor configuration.

Proven Technology Holds Its Value

Digital's VAX system family continues to lead the industry in price/performance for commercial systems that beat even RISC machines from vendors such as IBM and Hewlett-Packard (see accompanying illustration for recent benchmark test results). Long known for expandability and flexibility from desktop to data center, VAX systems also offer clear migration paths to Alpha to ensure smooth and easy portability of VMS applications.

These features, combined with the open standards support in the VMS operating system and Digital's top networking and multivendor integration capabilities, ensure the viability of today's applications and establish VAX computers as leading open systems.

Digital's DECsystem family of RISC computers offers fast, well-balanced performance at low prices. Based on chips from MIPS Computer Systems, Inc, DECsystem and DECstation computers are well positioned to take advantage of technological advances as they happen with features such as daughtercard upgrades which allow for the quick replacement of the processor chip, resulting in a far more powerful system.

Long known for expandability and flexibility from desktop to data center, VAX systems also offer clear migration paths to Alpha.

Digital continues to develop new MIPS-based machines, with plans to expand the family with systems based on the 64-bit MIPS R4000 chip. Like VAX systems, DECsystem machines will offer clear migration paths to Alpha to ensure smooth and easy portability of existing applications.

Giving Alpha Enthusiasts a Head Start

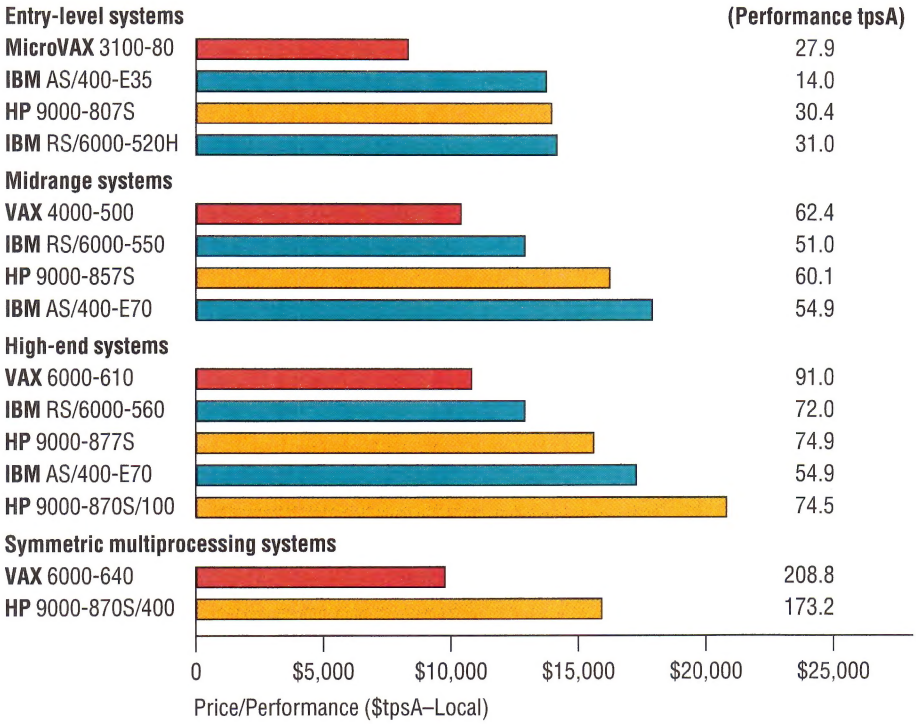
Organizations seeking immediate expansion of their computing capabilities don't have to wait for the release of Alpha

systems. They can get additional power and performance *now* through Digital's current offerings.

Organizations can purchase a VAX or DECsystem computer today with confidence in knowing that Digital is establishing a clear, well-planned path to a future that includes Alpha-based systems. Moreover, to further protect computing investments, Alpha-based machines will run the operating systems and software running on VAX and DECsystem machines today as well as use many of the same hardware components. For example, Alpha-based systems will support today's buses including TURBOchannel, Futurebus+, XMI, Ethernet, FDDI, SCSI, DSSI, CI, and SDI. To ensure smooth migrations to Alpha-based systems, Digital will offer tools, training, and consulting in cities around the globe.

The introduction of Alpha-based systems preserves the value of today's configurations with VAX and DECsystem computers. Digital will continue to enhance both computing lines so they will continue to deliver proven and reliable computing for many years to come.

Digital's CISC Systems Beat RISC Offerings in Benchmarks*



*Digital results audited by KPMG Peat Marwick in late March, 1992.

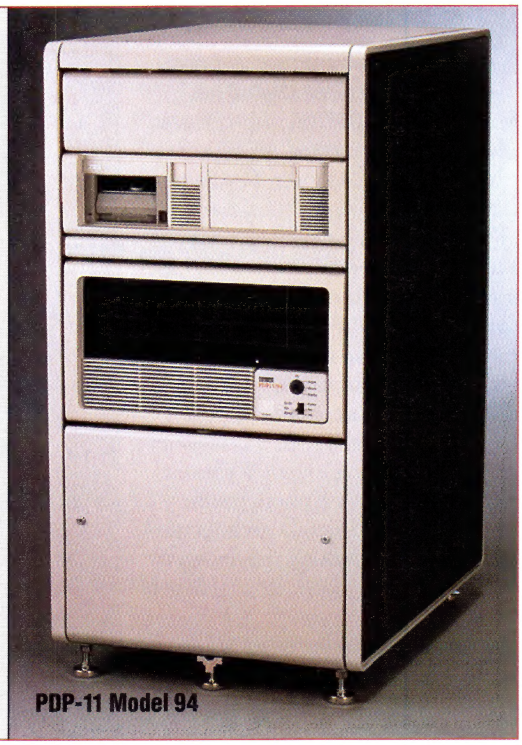
PDP Systems Remain Ageless in New Technological Era

Although technological obsolescence strikes many computer manufacturers' products, Digital's PDP-11 architecture is enjoying a ripe old age. Since the first PDP-11 minicomputer was introduced nearly 22 years ago, Digital has shipped more than 600,000 PDP-11 systems. Today, customer demand for PDP systems is still strong.

To achieve such longevity, the PDP system design has had to change with the times while retaining compatibility with earlier systems. The newest PDP systems, the PDP-11/93 and PDP-11/94 computers, are about the same size and cost as the original PDP-11/20 computer. But the new systems offer 250 times the memory capacity and 47 times the performance of the older PDP design. And the latest PDP-11 systems can run software developed for earlier models, and vice versa.

Even in the most well-architected product line, product phaseouts occur over time to make room for more powerful, less expensive systems – as happened last year with the retirement of the PDP-11/83 and PDP-11/84 systems. But such consolidations should not be interpreted as a sign that Digital is putting the PDP-11 architecture out to pasture.

In fact, Digital expects to market PDP-11 systems for a long time, as evidenced by the recent announcement of new PDP-11 system building blocks utilizing the industry-standard small computer systems interface (SCSI).



PDP-11 Model 94

Leasing Offers an Alternate Route to New Advances

The rapid pace of technological change, combined with the uncertainties of today's business world, are causing many companies to postpone computing purchases. But most businesses can't afford to ignore new technologies as competitive pressures and operating expenses mount.

To help businesses stay on the leading edge of technology and ahead of their competition while conserving their working capital, Digital offers a complete system-leasing program. Available for the entire range of VAX and DECsystem families, Digital's leasing program enables companies to take advantage of the best technologies, yet remain free to adopt future technologies as they are introduced.

Leasing is an attractive alternative for businesses interested in systems now in development that are based on Digital's 21064 chip. The processor is the first offering of Digital's new architecture, also known by the code name Alpha.

Digital's leasing program delivers a variety of plans, rates, and services to meet a wide range of business requirements. The following table highlights Digital's leasing options for businesses looking for a "bridge" solution to future technologies.

Examining Digital's Leasing Portfolio

Plan	Products	End of lease option	Lease term	Type of lease	Feature
Platform lease	VAX 6000, VAX 4000 Models 300 and 500	Fair market value	36 months	Operating/Capital	Rate guarantee for future CPU upgrade
Technology migration lease	All	10%[1]	Varies	Capital	Lease buyout table provided after first 12 payments
18/36 month bridge lease	All	Fair market value or 10%[1]	54 months	Operating/Capital	Lease structure with CPU upgrade window at 18th month

[1]A purchase option equal to 10% of the selling price of the original system under lease

Open Technology Leads to Partnership

As part of its commitment to open business practices, Digital has licensed its new RISC microprocessor technology, code-named Alpha, to Kubota Pacific Computer. The Santa Clara, California-based subsidiary of Kubota Ltd., a diversified manufacturer of heavy equipment and building materials, Kubota Pacific will use Digital's 21064 RISC chip in its next generation of Titan multiprocessor graphics supercomputers.

Kubota's current systems utilize RISC processors from MIPS Computer Systems. According to Ben Wegbreit, chairman and CEO, Kubota Pacific carefully studied Digital's architectural specifications and found the design to be an exceedingly powerful and durable platform.

"Our confidence in Alpha is not merely based on a hasty examination of raw SPECmark estimates," he said.

Photo: Monty Abbott

Digital President Kenneth H. Olsen and Kubota Chairman and CEO Ben Wegbreit

"Digital has been very open with us about sharing detailed information on the design, and we're confident that Alpha is the best technology in the industry."

Wegbreit reports that first customer shipments of Kubota's 21064-based Titan systems are expected by the end of the year. By coupling its advanced 3-D graphics technology with Digital's superior processor technology, Kubota Pacific intends to develop a full range of high-performance graphics and imaging products – from desktop units to data center systems.

"Digital's plan for a series of higher-performance, lower-cost follow-on products will enable Alpha to sustain its price-performance excellence into the future," said Wegbreit. "That is what every computer systems builder – and ultimately every computer buyer – wants."

DEC OSF/1 Systems Outperform the UNIX Field

With the February introduction of its new RISC microprocessor technology, code-named Alpha, Digital is poised to deliver the industry's leading OSF/1 platform. The second release of the DEC OSF/1 operating system will take advantage of Digital's new 64-bit, high-performance architecture while continuing to support existing features.

These features include a fully integrated OSF/Motif graphical user interface, shared libraries, realtime extensions, Logical Volume Manager software, DECthreads software, and X11R4 X Window Server software.

Users of most MIPS-based DECsystem workstations and servers can run DEC OSF/1 software today, confident that they can port their applications to Digital's new architecture by simply recompiling and linking. Users of ULTRIX applications can also easily move to DEC OSF/1 software because of the high level of ULTRIX compatibility in DEC OSF/1 software. Digital will offer several tools to assist software developers, such as a binary translator for performing easy ULTRIX-to-Alpha conversions, as well as an enhanced LINT tool for handling C-language-specific datatypes.

Such easy software portability means investment protection. You can purchase MIPS-based DECstation and DECsystem computers today running either ULTRIX or DEC OSF/1 software with the assurance that your applications will move easily to Digital's new high-performance RISC systems.

Developers Speak Out on DEC OSF/1

We see tremendous synergy between our products and Digital's new operating system. DEC OSF/1 allows developers to build applications that run on a variety of platforms and support industry standards.

Matthew Szulik, vice president of marketing, Interleaf, Inc., Waltham, Massachusetts

DEC OSF/1 represents an important step in making UNIX a more widely accepted commercial product. The standards provided by DEC OSF/1 should benefit both end users and software developers.

Kenneyth Griffin, president, Decathlon Data Systems, Inc., Boulder, Colorado

DEC OSF/1 represents a major step towards making the dream of open systems a reality. DEC OSF/1 will greatly simplify the lives of both users and software tool suppliers.

Alain Roan, marketing director, Verilog USA, Dallas, Texas

We believe that DEC OSF/1 is a very important platform for our software products, both in the DECstation market and in the larger context of the ACE initiative. We have found the port of our products to be nearly effortless.

Arthur Coston, president, Applied Information Systems, Inc., Chapel Hill, North Carolina

Mentor Graphics applauds Digital's leadership in bringing a common UNIX development environment to the engineering community. We remain firmly committed to making our entire software product line compatible with emerging OSF standards.

Phil Robinson, president, Concurrent Engineering Group, Mentor Graphics Corp. Beaverton, Oregon

We want to support one application across a broad spectrum of hardware and operating systems so that our level of service can increase and our development costs decrease. To do that, our entire development effort stayed within the bounds of open systems standards. Supporting DEC OSF/1 is an extension of this philosophy.

Steve Eylar, vice president of engineering, Intelligent Networks, Inc., Herndon, Virginia

The DEC OSF/1 operating system is an important technology because the standards it supports will provide developers with new capabilities and users with access to additional functionality. We applaud Digital for its commitment to the cause.

Michael Godley, vice president of marketing, Sigma Designs, Burlington, Massachusetts

This is a significant introduction and a milestone for enterprisewide corporate computing standards.

Minish Mehta, vice president of midrange systems, Oracle Corp., Redwood Shores, California

VAX VMS or Alpha VMS? It'll Look the Same to You

The VMS operating system has been part of the computing experience for millions of users over the past decade. And it will remain that way for decades to come.

As evidenced by Digital's 21064 chip, RISC processors will power the fastest systems of the future. And today's VAX VMS users are in an ideal position to take advantage of the smoothest CISC-to-RISC transition ever possible. They will be able to preserve existing information system investments, encompassing applications, data, peripherals, and training.

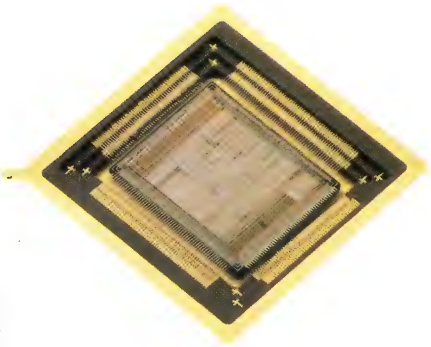


Photo: Monty Abbott

21064 chip

From a user perspective, the VMS operating system for Digital's RISC architecture, code-named Alpha, will just be another version of VMS. It has not been rewritten or redesigned. Moving most VMS applications from the VAX to the Alpha architecture will be easy: it'll just take a simple recompile, relink, and run…but with a substantial gain in performance.

Digital will also provide a tool to translate VAX VMS executable images into Alpha VMS executable images. This tool will be valuable for users of applications written in a language for which an Alpha VMS compiler is not yet available, or for applications where the original VMS source code is not available. Recompiled application code always will show greater increases in performance than will translated application code.

Beta test results have verified the easy transition from VAX VMS to Alpha VMS. Even the migration of complex VMS code has gone smoothly and ahead of schedule. Many third-party applications will be available by this year's end, and many more will become available in 1993.

Timing the Move

The operating system and layered software for Alpha VMS will be released in phases, beginning later this year.

The first phase will include the base operating system and software needed for application development and deployment. Subsequent phases will provide additional functionality such as RMS journaling, symmetric multiprocessing, and cluster support. VAX VMS and Alpha VMS systems will be able to coexist in the same cluster.

Digital intends to bring the features in VAX VMS and Alpha VMS versions to parity as quickly as possible. Therefore, sites can feel comfortable moving ahead to new VMS versions, which run on the newest VAX processors and have the latest operating system functionality, such as support for the POSIX standard.

It'll just take a simple recompile, relink, and run… but with a substantial gain in performance.

Standards support in the VMS operating system – such as OSI, X.400 CCITT, and SQL – provides users with the application portability and interoperability requisite of an open system. Because VMS supports many open standards today, it often serves a key integration role at multivendor computing installations.

With VMS as the common denominator, people, as well as applications, will be able to move between VAX VMS and Alpha VMS systems with ease. Users will see the same familiar interfaces, whether they use an editor and electronic mail on a character-cell terminal, or DECwindows Motif applications on a workstation. System managers will be able to use the same utilities and commands for managing VAX VMS systems when managing Alpha systems. Programmers with experience developing applications for VAX VMS systems will have the same familiar software development tools with Alpha VMS.

By moving ahead with new versions, millions of VMS users can stay on top of

Microsoft to Support New RISC Chip

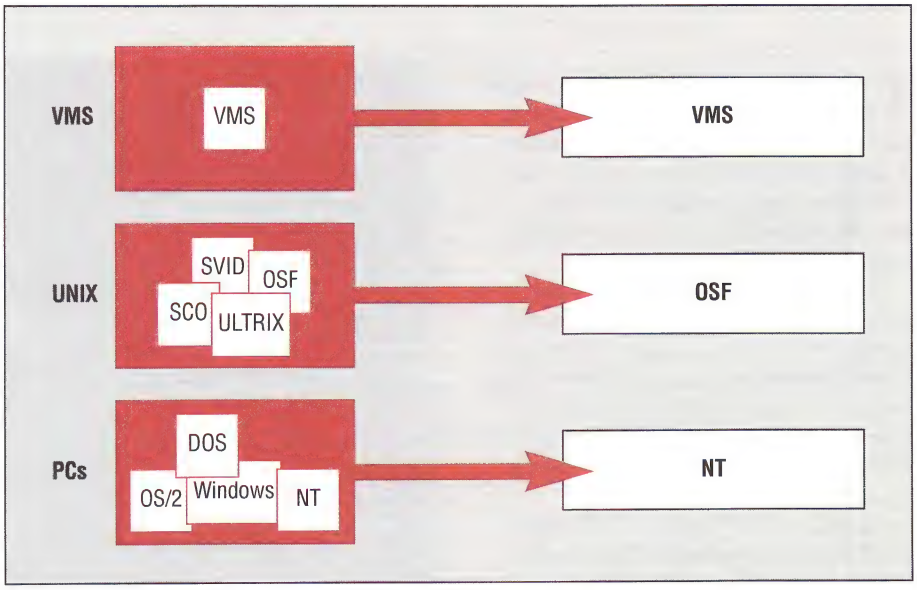
Microsoft Corporation was one of the first software companies to announce its support for Digital's new 64-bit RISC architecture, code-named Alpha. Microsoft has said it intends to make its next-generation Windows NT operating system available on systems using the new processor technology.

Microsoft Windows NT, a follow-on to the industry-standard MS-DOS operating system used in Intel chip-based personal computers, will utilize the popular Windows graphical user interface. But the operating system internals underlying Windows NT will provide users with powerful new features such as virtual memory, true multitasking, and support for 64-bit addressing.

With first customer shipments expected by the end of this year, Windows NT software is one of the operating system platforms specified by the ACE initiative. In addition to supporting systems based on Digital's new RISC architecture, Windows NT will run on Intel-based systems and RISC systems built around processors from MIPS Computer Systems.

the price/performance curve, maximize the use of open standards, and be ready to leap far ahead of competitors that have non-Digital platforms. That's what investment protection is all about.

Open Operating Systems Strategy



The industry trend towards open operating systems is clear. Digital has responded by moving its VMS operating system to comply with major industry standards, such as POSIX, and merging its own ULTRIX operating system with a unified, industry version of UNIX – the OSF operating system. Even PC operating systems seem to be narrowing in on a single focus.

SAS Reports Alpha Transition a Success

Migrating an existing application from a VAX VMS platform to an Alpha VMS platform can happen quickly and easily, as evidenced by SAS Institute, Inc., a Digital field test site. SAS Institute, based in Cary, North Carolina, produces the SAS System offering – a suite of software for accessing, managing, analyzing and presenting data – that runs on over 17 industry platforms and serves more than three million users.

"It is certainly true that the port that we're undertaking now to Alpha VMS has gone incredibly smoothly and in a very short period of time," said Tom Cole, manager of VMS host development, SAS Institute, "It has been no more difficult than any of our ports between UNIX platforms, which is considered the definitive open system. In some ways, it's been even easier because we have a huge amount of operating system-specific code that ported with almost no change."

The SAS System – which runs on systems from such vendors as IBM, Hewlett-Packard, and Sun – includes 3.5 million lines of code, 450,000 of which are platform specific. Unlike most VAX VMS code, which can be simply recompiled and run on an Alpha VMS system, the SAS System code contains unique architectural dependencies. These anomalies exist because there are many low-level links to the hardware and the operating system to maximize the "look and feel" between different platforms. Affected VMS internals include exception handling, code generation, and image activation.

This SAS data analysis tool runs here on the ULTRIX operating system with the OSF/Motif user interface. In addition to porting the SAS System from the VAX VMS to Alpha platform, SAS Institute – a Digital CMP since 1987 – is currently evaluating support for the DEC OSF operating system.

"With the Alpha project, Digital has really bent over backwards to accommodate our unusual technical requirements," said Cole. "Digital has shared tools and libraries with us to help us meet our needs. We've submitted a long stream of questions, and received a long stream of very well-written answers."

Open technology coupled with open business practices? Porting Digital applications was never easier.

Networks Play in Three-part Harmony

To keep humming merrily along, a stride ahead of the competition, businesses need virtuosic accompaniment. The pace is quick; the demands are complex; and with technology changing faster than a jazz riff, adaptability is the most valuable trait of all.

The whole idea of open computing is to harness rapid technological change to competitive advantage. Faster computers, slicker printers, and improved productivity software are quickly assimilated into the computing repertoire. And it's the network that keeps all of that computing playing together.

Digital's ADVANTAGE-NETWORKS products give open computing almost limitless range. In a single network, the ADVANTAGE-NETWORKS solution integrates three leading multivendor platform protocols – for OSI, TCP/IP, and DECnet networks – into harmonious coexistence. Even SNA can get into the act with Digital's gateways.

Why three protocols? Propelled by the popularity of UNIX systems, TCP/IP has become a de facto standard for multivendor computing. Millions of computers are running it. Worldwide, the more extensive features of OSI (Open System Interconnect) are required for multivendor communication – particularly by governments. In fact, the United Kingdom, Australia, and the United States have mandated OSI through their Government OSI Profile (GOSIP) policies. And DECnet networks, in existence for over 17 years, represent a huge installed base of users who look for continued support and enhancements.

In Tune with Open Technology

Most computer companies provide open, industry-standard interconnection, generally by adding standards-based features to a fundamentally proprietary network.

On the other hand, Digital's commitment to standards is much stronger. De facto standard and industry standard protocols are the core of the ADVANTAGE-NETWORKS solution. The need for multivendor connectivity is assumed and built into each product.

Available for both the UNIX and VMS operating systems, ADVANTAGE-NETWORKS is a suite of multiprotocol networking products. DECnet/OSI products for each operating system combine DECnet Phase IV and OSI protocols and conform with GOSIP specifications. Full TCP/IP support is already bundled into Digital's UNIX operating system and available for VMS systems through optional DEC TCP/IP Services (formerly VMS/ULTRIX Connection), so a single system can serve all protocols.

The ADVANTAGE-NETWORKS portfolio also includes multiprotocol wide area network (WAN) routers and gateways. And all ADVANTAGE-NETWORKS products integrate with Digital's complete open product line, which delivers the array of capabilities necessary for a fully functional multivendor network. These capabilities include X.400 electronic messaging, electronic document interchange, and terminal servers for local area networks.

The channels over which ADVANTAGE-NETWORKS computing resources communicate run the gamut of network-backbone technologies, from leased lines to 802.3/Ethernet to high-speed FDDI – and all the devices to connect them.

The Maestro of Multivendor Networks

Even when OSI, TCP/IP, and DECnet voices are blended, coordinating a multitude of

Opening Up to PC Networks

Digital recently announced reseller arrangements with Banyan Systems, Inc., and Microsoft Corporation. Under the agreements, Digital will sell, service, and support Banyan's Vines and Microsoft's LAN Manager network operating systems software. Digital now offers one-stop shopping for PC and high-end networking.

network resources is difficult if they don't respond to one management "baton."

Digital's DECmcc family of open network and systems management products puts all network devices under the control of a single, integrated network manager. Based on Digital's Enterprise Management Architecture (EMA), DECmcc enables organizations to monitor and control all multivendor network nodes and communications lines from a single VAX VMS or RISC UNIX workstation, or from several coordinated stations, if that's preferred.

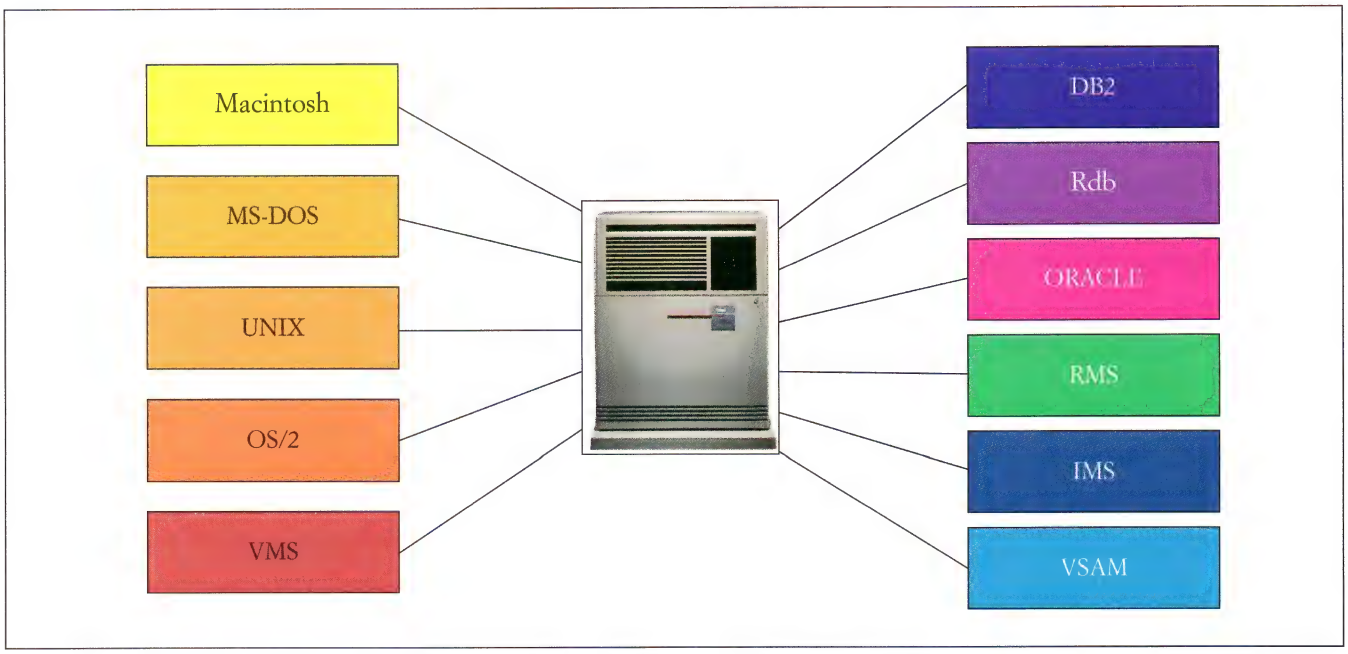
DECmcc offers extensive, industry-standard Simple Network Management Protocol (SNMP) management capabilities. It also features Digital's own management tools for TCP/IP, OSI, and DECnet network management. Because EMA is a modular architecture, the management system is extendible and scalable to suit any need, from a simple network in a single building, to a complex network spanning from Boston to Bangkok.

The ADVANTAGE-NETWORKS solution gives multiprotocol networking center stage. And with Digital's full line of open networking products and services, multivendor computer networks work in concert for the benefit of an entire organization.

Digital's Open Networking Products at a Glance

Products	Description
ADVANTAGE-NETWORKS software products	
DECnet/OSI for ULTRIX and DECnet/OSI for VMS software	Offer GOSIP-conforming OSI and DECnet networking.
DEC TCP/IP Services for VMS product	Supports TCP/IP protocols (NFS Server, SMTP, SNMP) on VMS systems, and offers FDDI connections.
DECnet/SCO for UNIX product	Provides DECnet Phase IV communications for SCO UNIX platforms.
OSI Application Developer's Toolkit	Supplies the APIs and an ASN.1 compiler for developing OSI applications.
ADVANTAGE-NETWORKS routing products	
DEC Network Integration Servers (DECNIS)	Offers modular, high-performance, standards-based multiprotocol routing and bridging, and an X.25 gateway for LAN/WAN integration.
DEC WANrouter family	Provides standards-based TCP/IP, OSI, and DECnet routing over leased lines, X.25, or Frame Relay networks.
DEC X.25 gateway products	Enable DECnet systems to communicate over an X.25 WAN.
LAN products	
DECserver 300 product	Supports concurrent TCP/IP Telnet and LAT terminal sessions to Digital and non-Digital hosts.
802.5/Token Ring program	Allows DECnet systems to be connected to a Token Ring network.
DECnet/SNA DTF product	Offers consistent, transparent file transfer between IBM VM or IBM MVS host systems and DECnet nodes.
DECbridge series	Interconnects 802.3/Ethernet and FDDI networks.
FDDI support, including DEC FDDIcontroller family and FDDI copper options	Provides cost-effective FDDI connectivity for flexible, robust, high-performance networks.
Network management products	
DECmcc family	Delivers system and network management software for unified management and control of DECnet, TCP/IP, and OSI networks.
Other software products	
DEC X.25 and VAX P.S.I.	Provide communications software for linking ULTRIX and VMS systems to a PSDN.
Mailbus product	Supports a wide variety of electronic mail systems, including X.400, ALL-IN-1, Profs and SNADS, SMTP, VMSmail, and PC LAN mail applications.

Servers Can Integrate Multivendor Desktop Data



ACCESSWORKS products enable organizations to overcome the barriers to successful client/server computing. Based on the proven, commercial strength of VMS systems, ACCESSWORKS products provide users on a range of multivendor client systems with easy access to common databases such as DB2, Rdb/VMS, Oracle, RMS, IMS, and VSAM.

Looking for a cost-effective way to provide database access throughout your organization, regardless of desktop device? According to a recent study by the Waltham, Massachusetts-based Business Research Group (BRG), more than two-thirds of the 300 organizations studied have implemented client/server systems. Seventy-five percent of these organizations are using client/server approaches to support mission critical applications.

Yet easy data access – along with the productivity gains and lower operating costs promised by client/server computing – continues to elude many organizations. The BRG study, which focused on both large and medium-sized businesses, found that early adopters of client/server systems have encountered numerous obstacles to success. These barriers include unproven technology, dependence on existing systems, lack of vendor support, high costs, and scarcity of software tools.

But some organizations are avoiding such problems with a robust, manageable, and cost-effective way to integrate information throughout the enterprise: Digital's ACCESSWORKS family of client/server products.

Gain Easy Access to Existing Systems

Digital has been implementing client/server solutions longer than anyone in the industry. Digital's ACCESSWORKS products provide preconfigured, tested, and characterized client/server solutions based on the proven commercial strength of VMS systems. Offering the ability to access different databases from remote systems, ACCESSWORKS supports the Structured Query Language (SQL) used for common databases such as IBM DB2,

The ACCESSWORKS Family of Client/Server Solutions

Client/server workload	ACCESSWORKS solution	Platform
Pilots/teams	ACCESSWORKS 3130	MicroVAX 3100 Model 30
Departments/workgroups	ACCESSWORKS 3180	MicroVAX 3100 Model 80
Medium groups, high I/O	ACCESSWORKS 4300	VAX 4000 Model 300
Medium/large groups	ACCESSWORKS 4500	VAX 4000 Model 500
Applications users requiring maximum performance	ACCESSWORKS 6610	VAX 6000 Model 610
High-availability production systems	ACCESSWORKS 4500HA	VAX 4000 Model 500
High-availability production systems	ACCESSWORKS 6610HA	VAX 6000 Model 610

VSAM, ORACLE, VAX Rdb/VMS, and RMS products. In addition, ACCESSWORKS provides tools for integrating other databases and software.

ACCESSWORKS offers users concurrent, transparent access to a variety of multivendor data sources. It also supports a range of client devices, including MS-DOS, OS/2, Macintosh, Sun, VMS, and UNIX systems, so that existing systems can work with an ACCESSWORKS solution.

Each of the seven packaged ACCESSWORKS configurations comes with core software tools (VAX Rdb/VMS, DECwindows/Motif, CDD/Plus, and RMS Access software) and Digital's NAS packages for VMS software. Also provided are interactive read-write external connects to both VAX Rdb/VMS and RMS databases. Optional read-access database connects include ORACLE, DB2, VSAM, and IMS software via either ST or CT gateways, with an optional data store capability.

Digital has also released plans to offer interactive write access for DB2 and ORACLE databases, as well as plans for Deferred Query and Management Director functionality. In addition, Digital will support SQL ACCESS group standards for even greater database connectivity.

Besides ensuring investment protection, ACCESSWORKS gives you maximum flexibility in selecting databases for new applications.

Also packaged with each ACCESSWORKS solution is powerful server software, including PATHWORKS for VMS network operating system software and DECnet-VAX and DEC TCP/IP Services software. You can select your ACCESSWORKS solution based on your organization's expected workload.

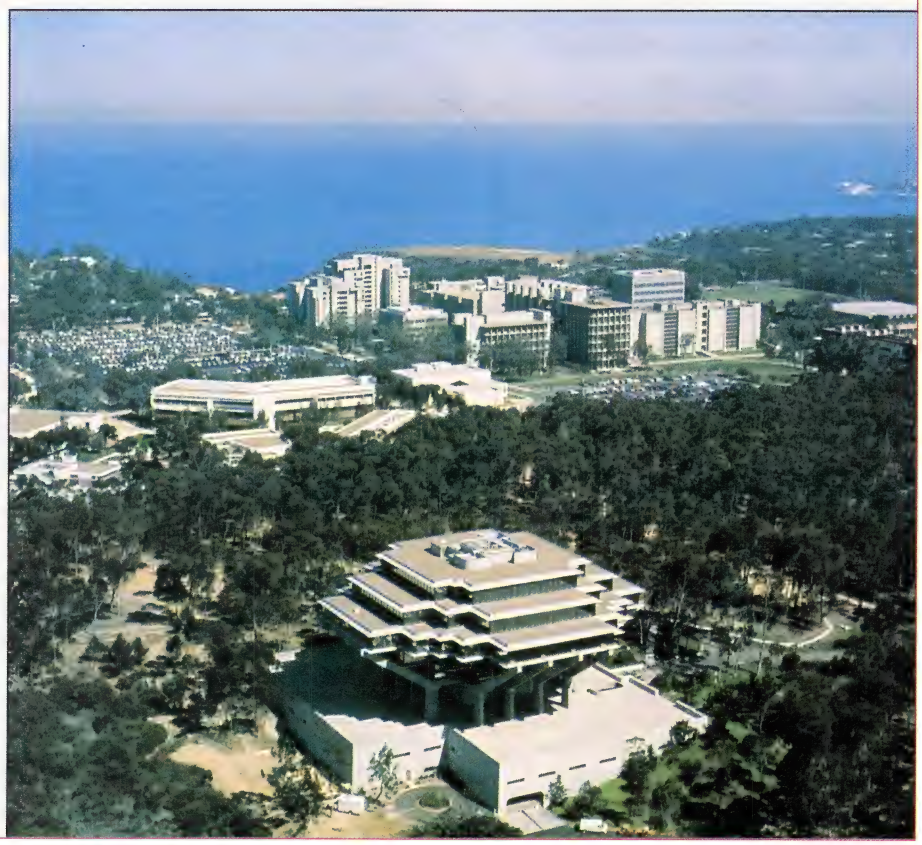
With ACCESSWORKS, your organization can access its various databases without making major modifications to existing systems. Besides ensuring investment protection, ACCESSWORKS gives you maximum flexibility in selecting databases for new applications. Best of all, you can put ACCESSWORKS directly to work now, providing personnel with access to critical organizational information, from desktop to data center.

UC San Diego Discovers Speedy Data Access

Talk about sneakernet: when administrators using PCs at the University of California at San Diego (UCSD) wanted to access payroll or personnel data from an IBM mainframe database, the data had to be extracted from the mainframe, transferred to tape, and then shipped to the person who requested it. Finally, the UCSD administrator had to convert the tape to diskettes before he or she could utilize the data.

Thanks to a client/server solution based on Digital's ACCESSWORKS products, UCSD administrators can now instantly access the university's mainframe data using their desktop PCs, Macintosh computers, and Sun or Digital workstations. Each desktop client communicates with an ACCESSWORKS 4300 server over TCP/IP networks.

ACCESSWORKS software on the VAX server determines where the data requested by the client is located – whether on the IBM mainframe or the ACCESSWORKS system itself – retrieves the data, and sends it to the client. The UCSD program has been so successful that both administrative and academic departments at the other eight University of California campuses are investigating their own ACCESSWORKS solutions.



Leading the Way to Multivendor System Management

Management of the open computing environment presents a challenge that few vendors can even begin to answer. The need for a solution, however, is urgent in a time when organizations are struggling to manage increasingly complex, multivendor production systems and plan for future needs – while continuing to deliver quality services with smaller staffs and tighter budgets.

Digital took the lead in responding to this challenge last year when it announced the POLYCENTER solution for management of multiplatform, multivendor computing. The first POLYCENTER offerings featured, among others, Digital's DECmcc Director platform for integrating system and network management applications, DECperformance Solution (DECps), Remote Environmental Monitoring Software (REMS), and DECinspect systems security software.

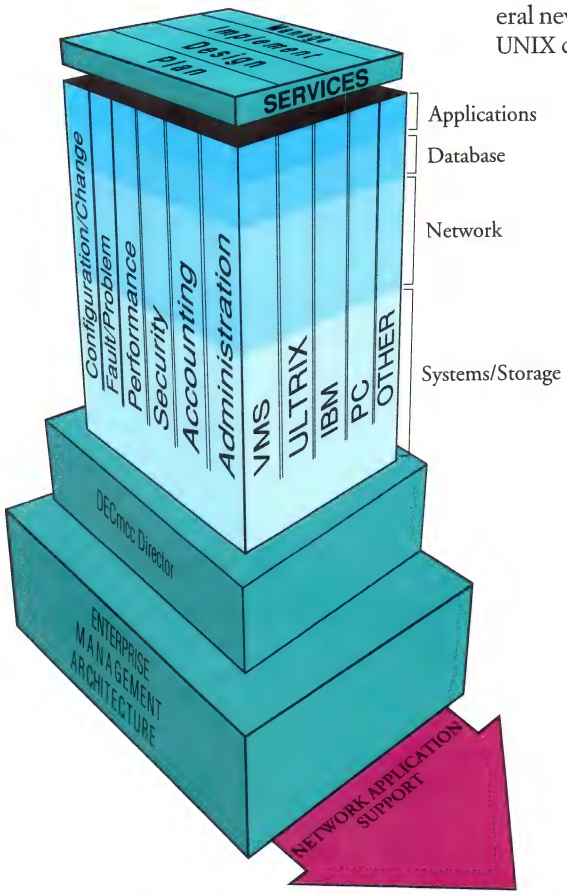
POLYCENTER is both a planned approach to total multivendor operations management and a solution that companies can start using now.

POLYCENTER is both a planned approach to total multivendor operations management and a solution that companies can start using now. POLYCENTER provides Digital and third-party products and services, developed within Digital's Enterprise Management Architecture (EMA), to support the following management functions across VMS and UNIX platforms: configuration change, fault problem, performance, security, accounting, and administration.

Third-party products included among the first POLYCENTER offerings were UIS-PACS, a product of UIS, Inc., for resource accounting and chargeback, and Security Toolkit and ClydeSENTRY, products of RAXCO, for security assessment and control.

Products Do the Job Today

One year later, Digital is on schedule in its five-year plan to develop POLYCENTER into a total solution for centralized or distributed management of multivendor computing across an organization. Since February, Digital has unveiled more than two dozen new and enhanced products, services, and programs that advance POLYCENTER closer to that goal.



The POLYCENTER solution is solidly based on Digital's Enterprise Management Architecture (EMA) and DECmcc Director. EMA provides management services built on Digital's Network Application Support (NAS) open guidelines; DECmcc Director pulls together the enabling technologies for current and future POLYCENTER applications. The expanding POLYCENTER portfolio comprises products and services for essential areas of multiplatform, multivendor systems management.

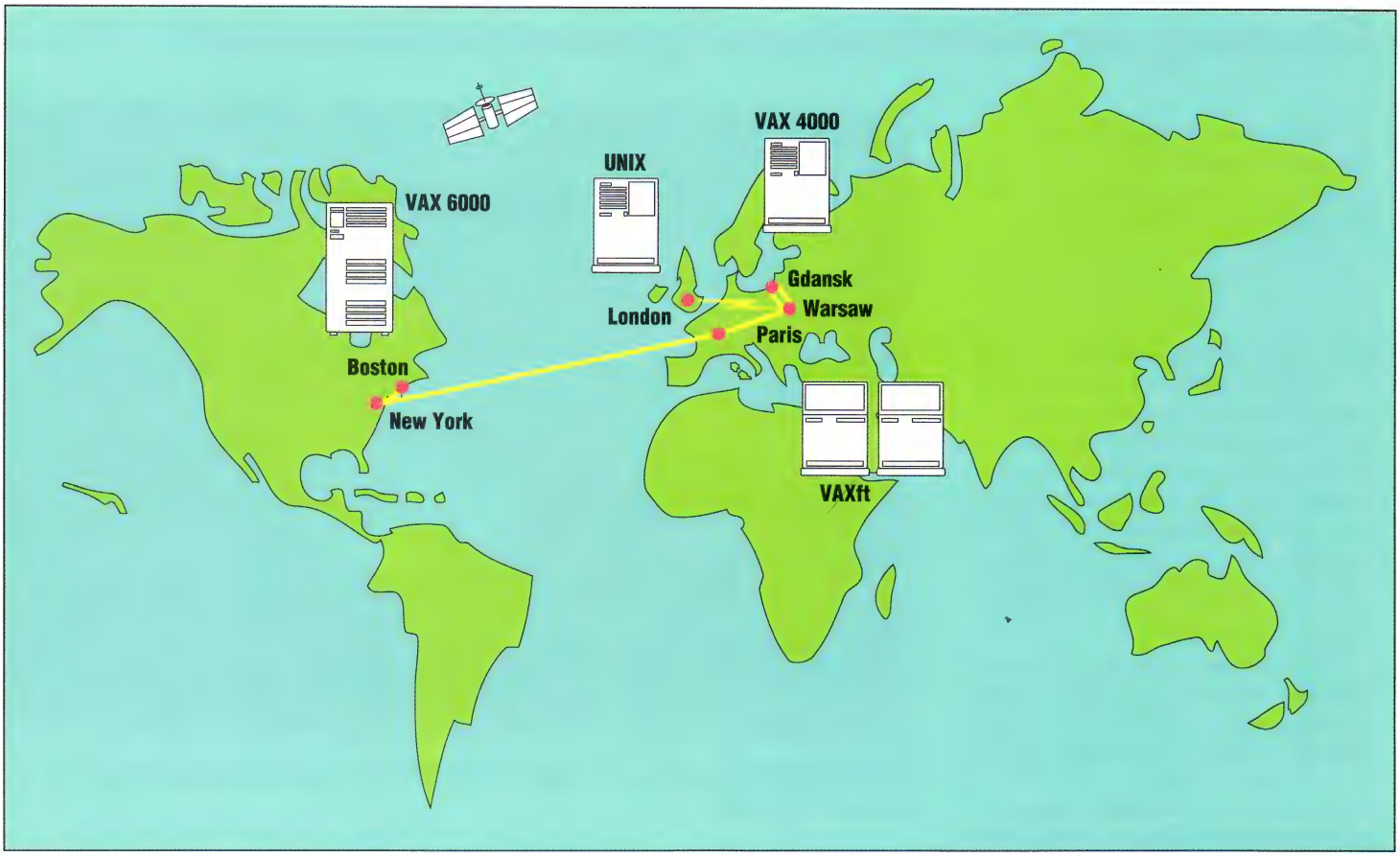
The recent introductions feature several new security management services for UNIX computing, including DECinspect Compliance Manager for ULTRIX and SunOS and new security services for UNIX. In addition, the new DECmcc ULTRIX Distributed Management PASS (Packaged Application Software Solution) greatly extends UNIX management capabilities.

Product enhancements include new versions of DECmcc for both VMS and UNIX with many significant added features, and ULTRIX client support for the DECscheduler and DECalert products.

Several new third-party products have also been added to the POLYCENTER portfolio. Computer Associates' CA-ARCHIVER product is now available for VAX systems. Also, UIS-HELPLINE, UIS-ARCHIVE Connection, and UIS-PACS Connection have been added to the POLYCENTER solution for VMS and ULTRIX management. Hancock Software and GEJAC are among a growing number of other vendors who have entered agreements to supply management products.

Digital's EMA guidelines, the basis for POLYCENTER products, make it easier to manage multivendor computing throughout an organization. Because Digital is committed to support open computing, the company makes its EMA specifications available without license to any vendor – including its competitors – for software development.

Every POLYCENTER product is or will be EMA-compliant. This means that



Managing a worldwide enterprise network is a formidable task, even when the network is composed of homogeneous systems. With heterogeneous systems, the task becomes down-right daunting. Digital's POLYCENTER solution enlists advanced system management products from Digital and leading third-party vendors to tackle centralized or distributed system management. POLYCENTER now integrates applications across networks of mixed UNIX and VMS systems and will soon encompass SunOS systems.

organizations can start developing customized POLYCENTER solutions now, confident of a smooth progression to total multivendor computing management without sacrificing existing investments.

All of which puts POLYCENTER right on schedule, moving toward multivendor management by first integrating applications across VMS and UNIX. There is still a long way to go, but Digital has taken a substantial lead in the race to provide truly open technology.

POLYCENTER Management Consulting Services

POLYCENTER Management Consulting Services (PMCS) enable information systems and operations managers to manage their computing resources more effectively and efficiently. PMCS consultants are senior Digital IS operations managers and consultants who have managed complex data centers themselves.

Three new PMCS services are available now:

Information Systems Operation Review (ISOR) – Examines current operations to identify areas for improvement, recommend ways to effect improvement, and confirm successful policies and procedures.

Lights Out Computing Design – Produces a plan for continuing improvement of overall business productivity as well as improvement and automation of the computing environment.

Information Systems Organization Design – Helps companies redesign their IS organizations and work processes by defining business purposes and designing work flows, management structures, tasks, and skill profiles.

Opening the Four Critical Application Domains

Choosing the best applications for the task at hand is never easy. And it becomes even more complicated when you must develop them yourself.

Whether purchasing existing applications or building new ones, it's important to ensure that your applications possess open attributes. Such features simplify integration with existing and future software.

Digital has the products and tools necessary for integration and development of the most critical applications *today.* Backed by Network Application Support (NAS), these offerings are grouped into four networked, integrated client/server domains: office, transaction processing (TP), computer-aided logistics support (CALS), and computer-aided software engineering (CASE).

The selection and implementation of industry standards varies greatly in these four critical areas. For this reason, Digital can offer a breadth of applications in some areas; for others, Digital can provide only the tools that can simplify the writing of open applications. But in all cases, Digital lays the groundwork to ensure interoperability and portability of applications.

With NAS middleware acting as the integrator, applications on systems from different vendors can work side by side.

Team Solutions Bring Users Together

To eliminate information barriers that prevent user groups from sharing data, Digital's office applications deliver a full spectrum of workgroup capabilities. Called "team solutions," these applications combine personal productivity tools, such as spreadsheets and word processors, with the robustness, power, and security of corporate back-end computing.

Team solutions span a wide range of hardware platforms, from PC LANs to mainframe systems, and are accessible from virtually any user interface. For example, TeamLinks products interoperate with the ALL-IN-1 Integrated Office System to enable users of different systems, such as machines running the MS-DOS, Macintosh, UNIX, and VMS operating systems, to exchange messages and share data. And Digital furnishes worldwide support for team solutions, including many third-party products.

As part of its efforts to provide open office applications, Digital teams with other vendors for development and support of each other's products. For example, Microsoft Corporation is currently enhancing its standard versions of Word for Windows and Excel to enable users to access NAS services transparently. Lotus Development Corporation also plans to integrate its Microsoft Windows-based suite of applications with NAS and TeamLinks.

> ***[Digital's approach is what] we have been waiting for all along – the ability for the user to continue working with familiar and favorite desktop apps [sic] while taking advantage of strong network-based services.***
>
> Patricia Seybold's Office Computing Group, *Office Computing Report,* Vol.15, No. 2, February 1992

Digital continues to aggressively develop productivity tools that can meet the changing needs of office system users.

DECtp Applications Open Desktops

Transaction processing applications, once limited to high-end proprietary computing, are now available for desktop computing. TP applications provide the highest levels of system performance and reliability, and Digital's DECtp solutions deliver the capabilities required to run parts of TP applications on a wide range of PCs and workstations.

By offering a host of networking transports, such as TCP/IP, DECnet, PATHWORKS, and Novell NETWARE products, DECtp solutions integrate almost every desktop client with ease, including machines running the MS-DOS, Macintosh, SCO UNIX, UNIX, and VMS operating systems. Client support for emerging platforms, such as the DEC OSF/1 and Windows NT operating systems, plus server support for UNIX systems is also planned.

DECtp solutions can also provide access to popular desktop software like the Neuron

Data Open Interface, Motif, DECforms, and Visual Basic products. Current DECtp solutions include the DEC RTR (Reliable Transaction Router) product, which supplies TP networking capabilities for VMS, ULTRIX, and MS-DOS clients.

To ensure the availability of truly open TP applications, Digital takes an active role in standards development and establishes alliances with other vendors for TP product development and support. Digital is working with vendors such as Microsoft, Novell, Andersen Consulting, and Mirus Corporation to develop open networking and application development tools for enterprise-wide computing.

ACMS now has a vast user base to tap into. It really opens up opportunities.

IDC as quoted in *Network World*, February 17, 1992.

Digital is currently integrating transaction monitors with its COHESION software development environment to increase capabilities for sites that want to write TP applications for distributed, open desktop computing.

CALS Sets the Standard for Efficiency

The CALS initiative, a government-led drive in the United States to standardize technical data and improve the efficiency of information systems, is now commanding the attention of the business community. Many corporate leaders are realizing that the well-defined, consistent information-sharing processes resulting from CALS can facilitate product development processes such as concurrent engineering, total quality management (TQM), and design for manufacture – thus reducing their time to market.

Digital, with its distributed systems expertise, strong support for standards, and extensive resources, is one of the few computer vendors that can develop and deliver complete CALS solutions. To ensure that CALS standards continue to meet the needs of both government and business, Digital actively participates in their development. For example, Digital is a long-time member of PDES Inc., a consortium of global companies formed to accelerate the PDES/STEP Standard for the Exchange of Product Model Data for CALS Phase II.

Digital's strong support for standards is also reflected in its architectures and products, which can accommodate both CALS-compliant and non-CALS-compliant products. The SGML Gateway product, for example, enables developers to edit documents developed with DECwrite software, and then tag and pass them directly to a government agency. Using DECview3D software, product team members can share, view, analyze, manipulate, and integrate CALS data. And the EDCS II product provides access and version control, change notification, audit trail, and review capabilities.

A recent alliance with Newport News Shipbuilding resulted in the Planning Workbench product, a maintenance and manufacturing planning tool, as well as CALS consulting services. Furthermore, Digital plans to introduce CALS Phase II products that meet the PDES/STEP standard this summer, including the EXPRESS information modeling language, and a STEP type library and related tools.

Faster time to market, reduced costs, and improved quality are some of the benefits defense contractors expect to reap by setting up CALS-compliant document exchange systems using software such as DECview3D.

Michael Puttre, associate editor, *Mechanical Engineering*, August 1991

COHESION Connects with Developers

Developers writing open software need complete solutions that address not only application development, but also the deployment, maintenance, and management of software across heterogenous systems. That's why Digital offers its COHESION solutions for software development, a comprehensive suite of methods, procedures, services, and integrated tools for many platforms that covers the entire development life cycle.

Built on NAS and a set of core products that enables information sharing and integration between multivendor systems, COHESION solutions integrate Digital, third-party, and custom tools in a common repository. The seven COHESION solutions are pre-engineered and integrated – which eliminates the need to design custom interfaces, processes, and methods, and speeds-up the application development process. COHESION solutions include:

- COHESION Starter Solution
- COHESION for Rapid Development
- COHESION for Transaction-Processing Development
- COHESION for Maintenance and Re-Engineering
- COHESION for IBM Cross-Development
- COHESION Aerospace and Defense/ Software Engineering Environment
- COHESION Technical/Embedded Software Engineering Solution for UNIX

COHESION solutions currently incorporate more than 100 software development tools and services from Digital, plus another 150 products from leading independent software vendors. The integration of tools from other vendors into COHESION solutions gives companies more flexibility in selecting the most appropriate application development approach for their businesses.

Digital's COHESION solutions support most standards-based development and delivery platforms for open application development, including the MS-DOS, UNIX, OSF/1, and VMS operating systems.

As soon as we began using this full set of COHESION tools, we started realizing additional productivity that we just hadn't seen before. The power to fix programs on the fly and move forward is terrifically enhanced!

Joe Mahn, director of information services, Northern Telecom's Switching Division, Raleigh, North Carolina

The products and tools in Digital's four networked, integrated client/server domains are giving more and more sites open applications – while sites without them can only imagine the possibilities.

Air Force Project Soars with Open Systems Expertise

The Military Aircraft Command building located at Scott Air Force Base, Illinois, forms the control site of the world's largest airline. Here, personnel keeps very busy tracking more than 1,700 flights a day.

While alertness and skill are the traits that have made the pilots in the United States Air Force the best in the world, it is the sophisticated command and control systems that keep their flights running smoothly. One key system is the Global Decision Support System (GDSS), a unique software application running on VAX VMS computers at seven networked air bases around the world.

Headquarters for GDSS operations are at Scott Air Force Base, Illinois, where a special Military Airlift Command (MAC) unit is employed to disseminate flight plans and monitor their execution using GDSS. The MAC team assigns planes from an inventory of more than 1,000 aircraft, including specifying routes, planning aerial refuelings, and coordinating cargo drops and pickups. Even in peace time, MAC operates the world's largest airline, with over 1,700 missions each day.

One of the biggest hurdles we have had to overcome is the lack of standards in the computer industry. The Digital team has implemented standards where they exist, and chosen the best path towards new standards where standards have not yet been set.

Major Paul Law, MLS program manager.

Recently, MAC began a major upgrade of GDSS to enhance security and increase reliance on accepted industry standards. Digital runs the Department of Defense (DoD) test bed for the upgrade, known as the Multi-Level Security project (MLS).

"Digital is doing a superb job in the open systems environment," said Major Paul Law, MLS program manager. "One of the biggest hurdles we have had to overcome is the lack of standards in the computer industry. The Digital team has implemented standards where they exist, and chosen the best path towards new standards where standards have not yet been set."

Standards Help the Project Take Off

The need to label data objects for varying levels of trust or security access was one problem the MLS team encountered. Such labels control access to data and utilities within an application.

Generally, different products from different vendors have their own labeling conventions. The operating system and the database may not recognize the same labels or the same privileges. The MLS team looked at numerous labeling conventions and created an intermediary that transcends these differences with a unified labeling scheme.

"We're definitely breaking some new ground here," Law said. "Prior to this effort, labeling standards didn't exist. Digital has instituted label management techniques that highlight and solve this problem until a future industry standard is determined."

This system is one of the first on the block that truly adheres to DoD standards and the DoD direction for standards. All application

C-5 Galaxy

coding is in Ada. Even places where the system talks to the operating system incorporates POSIX-like calls. Where the application talks to the database, ANSI-SQL is used. The screen forms adhere to the Forms Interface Management System (FIMS) standard.

This adoption of standards enables GDSS to interface with many other DoD systems and telecommunications networks. Equipment from many different vendors is involved, including Digital, Sun, Honeywell, and IBM. "GDSS has taken the lead as the integration agency for these many systems," said Eldon Schmidt, GDSS program manager.

Although GDSS is based on the VAX VMS architecture, the application is based on standards, so other DoD systems that are based on different architectures can incorporate much of the development work done for MLS.

"We're striving for an open system that fosters competition among many different vendors," Law said. "As better products come along we can easily incorporate them without rewriting the application code."

The great strides made in the realm of open systems by the MLS team were recently acknowledged on a national level. At the Federal Computer Conference last September, the "Best in Open Systems Solutions" award was given to Digital for its innovations on the MLS project. "This is an achievement that testifies to the importance of this open systems project and its ramifications for the entire Department of Defense," Law concluded.

VAX Keeps GDSS on the Move

Development of GDSS began in 1985 at Jet Propulsion Laboratories (JPL) in Pasadena, California. The first task confronting JPL was to settle on a computer platform capable of supporting complex communication networks, large relational databases, and powerful integration tools. The VAX VMS architecture best met these requirements and appeared to deliver a rich set of development capabilities. For these reasons, Digital was selected as the prime contractor.

Digital's VAX Rdb/VMS relational database management system was chosen for the distributed database capabilities required. And to streamline the development effort, JPL turned to SmartStar, an application development environment from SmartStar Corporation of Goleta, California, a member of Digital's Cooperative Marketing Program(CMP). SmartStar offers developers a rapid-prototyping approach to designing database applications.

The backbone of the system is three VAX 8000 computers at MAC headquarters.

With help from Digital, the JPL team created the command and control system that today links seven key air force sites on two continents and the Hawaiian Islands. The backbone of the system is three VAX 8000 computers at MAC headquarters (soon to be upgraded to a VAXcluster system made up of four VAX 6000 Model 610 computers).

The VAX systems are backed up by an array of MicroVAX computers that are connected, along with workstations and terminals in Ethernet local area networks at each of the seven locations. Graphical decision support tools, based on the X Window System interface, integrate the many GDSS functions for easy workstation access.

Connections among the various air bases are handled over a subset of the TCP/IP-based Defense Data Network. As a backup, an alternate data path is maintained via leased lines over a DECnet wide area network.

The fully replicated VAX Rdb/VMS database allows any GDSS site to assume the functions of any other GDSS site, should the primary site be lost for any reason. Error handling and correction algorithms at the database server level are handled by a message bus system that guarantees database consistency across all sites.

GDSS Completes the Mission

GDSS was put to the test like never before during the Gulf War. As conflict intensified in the Middle East, the American public watched one of the most complex military operations ever undertaken unfold. In what became known as Operation Desert Shield, more than a billion pounds of cargo was shipped to the Persian Gulf, the largest airlift in United States history.

While the American public witnessed this enormous preparation for war, the GDSS system was flawlessly directing the effort behind the scenes. And one overriding factor made it possible: the smooth flow of information.

Today it's business as usual at MAC headquarters. But careful coordination, split-second timing, and precise instructions remain the watch words here. With ongoing help from Digital, it's clear that the MAC team has got the "right stuff" for the job.

Lotus Network Blooms under Digital Management

The information network has emerged as a critical resource at companies today. Establishing a network and providing user connectivity is only part of the story. It's also necessary to maintain the network and ensure its availability.

Deciding how to effectively manage a computing network is a challenge for information systems organizations. According to Gene Cort, vice president of information services at Lotus Development Corporation, "It may not exactly be 'bet your company', but it certainly is 'bet your job.'"

Based in Cambridge, Massachusetts, Lotus boasts one of the most spectacular and consistent success stories in the world of high technology. Its Lotus 1-2-3 product has dominated the PC-based spreadsheet market for nearly 10 years. But as Lotus has grown, so have the demands on its corporate network, severely testing the organization's ability to provide basic network maintenance and repair.

"My team of engineers was constantly being diverted from primary network planning and development activities to troubleshoot and repair the network," explained Dan Rosen, data communications manager at Lotus. "Major projects were starting to lag behind. So, we were determined to find someone to help us out."

Rosen spoke with several vendors who supplied networking and communications equipment to Lotus. All were willing to service their own products, but none was willing or able to assume support of the entire multivendor network. Only Digital could deliver the multivendor network service and support that Lotus needed – despite the fact that the Lotus network includes few Digital components.

Photo: Mark Alcarez

My hunch was that Digital knew its networking business and was able to keep networks running better than I've seen other vendors do.

Gene Cort, vice president, information services, Lotus Development Corporation

Letting Engineers Focus on Development

Today, Digital provides single-source, all-inclusive network services and support for the Lotus computer network through its NETsupport Operations Management program. A four-person onsite team of Digital service engineers is responsible for end-to-end problem management for the entire Lotus network – from the back of the terminal or workstation to the data center. The team is supplemented by a rotating group of technicians to ensure continuous support, should a core team member become unavailable.

The Digital team at Lotus maintains and services the physical plant, including the extended Ethernet, broadband system, interbuilding links, and the wide area network, as well as the physical layer of all components, regardless of the brand name. The team also supplies regular reports and analyses to Lotus managers, allowing them to keep an eye on the network without becoming involved on a daily basis. The Lotus network is spread over 10 sites in four cities in greater Boston, Massachusetts. Lotus also maintains offices in Europe.

When Digital began providing network services and support for the Lotus network, the team had just a month and a half to assume full responsibility for the network. The Digital team not only met that six-week deadline but, more importantly, helped Lotus cut response time for network problems in half.

Cort is happy with Digital's performance from an information management perspective because he is now free to concentrate on building and enhancing the network. "My hunch was that Digital knew its networking business and was able to keep networks running better than I've seen other vendors do," he said. "I was not surprised, but really pleased with what I've seen of the networking side of Digital. It's a good business relationship and it's a good working relationship."

Digital's NETsupport solution keeps the computer network at Lotus up and running, which enables Lotus to move ahead in the race to develop new and exciting technologies.

Lotus Development Corporation needed a vendor to manage its multivendor computer network and only Digital could answer the call. Upon reflection, it's been nothing but smooth sailing for Lotus since Digital began providing all network service and support.

British National Power Turns to Network System

National Power, the largest electricity generator in Great Britain, has purchased more than $50 million in systems and services to form the backbone of a nationwide computer network, power station control system, and management information and business planning system.

The Digital system will network multivendor computers, including an Amdahl mainframe, through a DECnet SNA gateway, and also will integrate MS-DOS PCs. ALL-IN-1 Integrated Office System software will enable access to the network for more than 30 power stations. All facilities will be linked in a wide area network, with separate Ethernet local area networks running Personal Computer Systems Architecture (PCSA) and PATHWORKS software. National Power will also use more than 100 VAX computers and will employ Digital education, consulting, maintenance, and integration services as part of this project.

Packages Make Processing Healthy for Hospitals

Three healthcare providers in the United Kingdom's South-Western Regional Health Authority (SWRHA) have purchased Digital's VAXcluster Multi-Datacenter Facility (MDF) packages to provide disaster tolerance and high availability for their hospital information systems. The three packages are valued at $4.3 million.

The VAXcluster MDF solution combines hardware, software, and services that protect information from system failures by linking separate data centers into a single, large VAXcluster system. All 11 SWRHA hospitals currently use VAXcluster systems made up of VAX 6000 processors.

Integration Pays Off for Treasury Program

Digital will provide systems integration and support services for the U.S. Department of Treasury Telecommunications Program (DOTTS). As a subcontractor to General Analytics Corporation (GAC) of McLean, Virginia, Digital will deliver services such as site preparation, system staging, system installation and cutover, ongoing maintenance support, and customized technical and user training for the DOTTS project. Digital will provide these services on a continuous basis throughout the 10-year contract. Its estimated value for Digital is $80 million.

Digital's portion of the DOTTS project does not include computers of any kind. Instead, Digital will provide service and system integration for voice hardware supplied by NEC America and located at Treasury sites ranging from the Great Lakes to the Southwest and Alaska and Hawaii.

ULTRIX MLS+ Keeps U.S. Air Force Project on Course

McDonnell Douglas Electronic Systems company of McLean, Virginia, prime contractor for the U.S. Air Force Electronic Systems division's $40 million Automated Message Handling System (AMHS) project, is the recipient of the first shipment of Digital's ULTRIX MLS+ trusted operating system.

A realtime document analysis system running on local area networks, ULTRIX MLS+ provides the underlying security architecture for AMHS. The division plans to install ULTRIX MLS+ at over 50 locations worldwide.

VAXELN Software Gives Space Project a Lift

New Mexico State University's Particle Astrophysics Laboratory is using a VAX processor running VAXELN realtime software to gather information about cosmic rays in space –

Photo: Courtesy of New Mexico State University

all from a hot air balloon situated 110,000 feet above sea level. The data gathered by the single-board VAX processor in the balloon is transmitted via radio links to a DECnet network, where researchers retrieve, display, and analyze it using a VAXcluster system and other computers.

Digital Storage Poised to Open Solutions

Less than a wink in time ago, computers were mammoth boxes that stored their data on punch cards or large noisy magnetic disks. These slow-moving giants were an innovation, manipulating and transmitting information faster than was ever possible. Both computers and their storage media have since evolved. The smallest computers today can fit on your lap and store their data on palm-sized disks or tapes.

The pioneering days were a free-for-all of technological approaches. Fueled by innovations in capacity or performance, advances often made previous products obsolete. Digital realized that without standards, the information housed on one generation of computers could not be moved to the next generation.

As the industry had not addressed standards in this area, the company developed the Digital Storage Architecture (DSA), which provided guidelines around the VAX architecture. DSA-compliant devices adhere to strict specifications, are compatible with each other, and at the same time, track new technology.

Digital's recent disk and tape storage offerings carry on its tradition of supplying compatible, high-performance devices. Pictured are the RF35 disk drive, the Tx85 family of tape subsystems, and the SA300 DECarray 300 cabinet.

DSA Frames Advanced Storage Portfolio

DSA is a modular implementation, so data can migrate seamlessly from one interconnect to another. Adding a new Digital device involves little more than plugging it into the system. With built-in error-detection and error-correction code, DSA ensures the highest levels of data integrity.

Optimized for multiuser, time-sharing, and client/server computing, DSA offers features such as dual porting and volume shadowing to provide high availability. No other industry architecture supports all these features.

The DSA-based Storage Interconnect (SI) and Digital Storage Systems Interconnect (DSSI) products were designed to take advantage of Digital's operating system features, bus protocols, and data-retrieval mechanisms. DSSI storage solutions are especially suited for workgroups, small data centers, and fault-tolerant computing. SI products improve performance and capacity for high-end and midrange computing.

The Digital tradition of building new products on a tried-and-true foundation made sense 10 years ago, and it still does today. But everything changes. Industry standards have evolved for storage – Digital, in fact, is a major participant on

Sampler of Digital's Latest Storage Offerings

Product	Description
SA300 DECarray cabinet	Combines both DSSI and SI tape and disk products, providing flexibility for Digital storage devices.
SF35 building block	Stacks up to 12 RF35 drives.
RF35 Integrated Storage Element	Combines a controller and disk drive with an 852-Mbyte capacity.
SF220 DSSI Performance DECarray cabinet	Holds SF35, SF72, and SF73 capacity building blocks, and TF857 tape subsystems.
TF857 tape subsystem	Performs unattended backup of up to 18 Gbytes of data in less than eight hours.
SA900 DECarray cabinet	Holds 40 Gbytes of storage in a 67-inch high cabinet.
SCSI products	Include the RZ family of high-performance disk storage devices, the 1.2-Gbyte TLZ04 digital audio-tape drive, the 525-Mbyte TZK10 QIC tape drive, and the RRD42 compact-disc drive.

many leading standards committees such as IEEE and ANSI, and even those addressing specific storage areas, such as SCSI.

Organizations want the freedom that standards provide to mix software and firmware from many vendors. At the same time, VAX and DECsystem computer users are unwilling to give up the performance optimization, data integrity, availability, and reliability of Digital devices. Digital plans to provide investment protection, while at the same time extending its architecture to incorporate open standards.

New DSSI and SI disk drives, "next-generation" tape subsystems, and solid-state disks are planned within the year. The popular SCSI-2 device design standard is the basis for several planned SCSI tape and disk drives to balance the storage investment portfolio. Digital's depth of services and innovative software will tie current and future offerings together.

Digital has played, and continues to play, a large role in developing and manufacturing a profusion of storage products from the desktop to the datacenter. Digital's storage designs echo the company's intent to provide the products its users want, enhance existing systems with advanced technologies, and take on new markets with innovative solutions.

Digital Emerges as Token Ring Leader

If you're trying to integrate PCs, midrange systems, and mainframes in a seamless fashion, you want the freedom to choose the best local area network (LAN) interconnect technology for the situation. Often that means 802.3/Ethernet. Other times, 802.5/Token Ring or FDDI is the technology of choice.

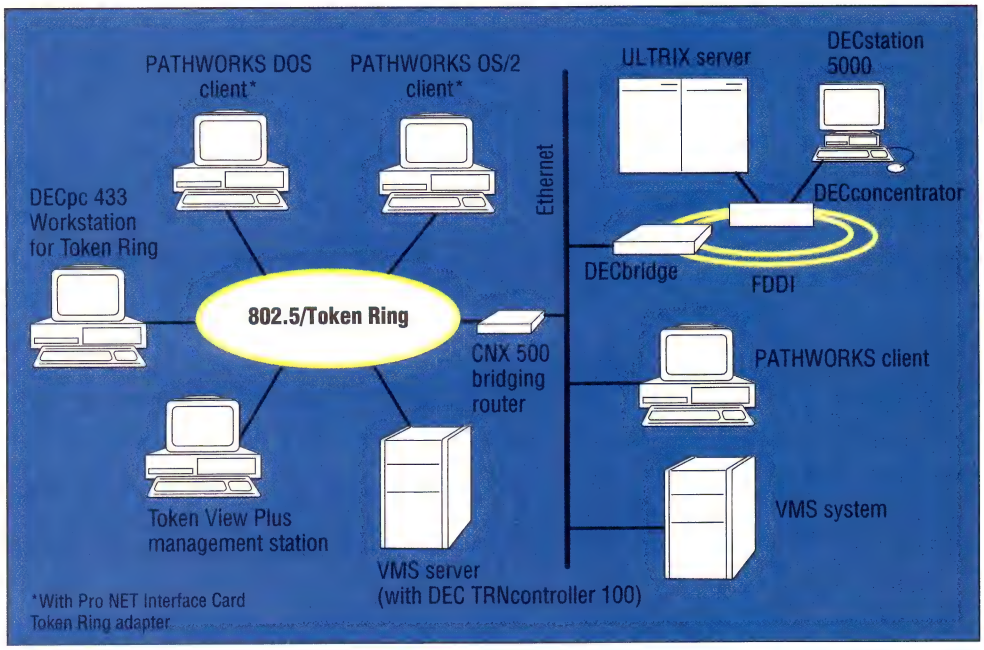
When you start to integrate multiple LANs into a robust, multivendor, multitechnology network, it's nice to have a single vendor supply system integration and management assistance. Long considered an expert in 802.3/Ethernet and FDDI LAN technology, Digital today offers impressive capabilities and a wide range of products for Token Ring networks.

Digital's 802.5/Token Ring portfolio, announced last year, combines expertise, products, and services to establish Digital as the leader in multivendor LAN and enterprise integration. Digital's comprehensive portfolio of 802.5/Token Ring products and services is unmatched in the industry. No other vendor – not even IBM, the first to offer Token Ring products – can deliver such a total solution.

Digital currently offers more than 100 Token Ring products. The list includes hardware such as ProNET PC network interface cards for industry-standard personal computers and the DEC TRNcontroller 100 interface card for VAX systems with the Q-bus interface. Cable plant components use the OPEN DECconnect wiring scheme to support both 802.5/Token Ring and 802.3/Ethernet protocols. The wealth of software solutions for Token Ring networks include Token View Plus management software and the PATHWORKS for Token Ring network operating system for client/server computing.

Digital also offers a full range of services to companies seeking a complete solution for planning and managing their organizational computing challenges. The single full-service vendor can seamlessly integrate all technologies.

Only Digital can provide applications and services to the Token Ring desktop… while managing the multivendor, multitechnology network environment.



Digital's portfolio of products and services for 802.5/Token Ring LANs enables desktop devices such as the DOS or OS/2 clients depicted here to become part of a corporate-wide network. This 802.5/Token Ring LAN includes a VAX VMS server equipped with a DEC TRNcontroller 100 adapter and is connected to an Ethernet backbone using Digital's CNX 500 bridging router. The configuration integrates a UNIX-based FDDI LAN through the DECconcentrator hardware. The 802.5/Token Ring LAN is managed from a Token View Plus management station, while DECmcc software manages the entire platform.

Digital Adheres to Environmental Policies

Digital is doing its part to clean up the environment by promoting recycling, reducing waste, and curtailing the use of ozone-harming chloroflurocarbons (CFCs). Facilities in Contoocook, New Hampshire, Nijmegen, the Netherlands, and San German, Puerto Rico, all have won awards for promoting environmentally sound policies that also save the company money.

The Property Disposition Center in Contoocook saved an estimated $1 million by recycling video tubes in monitors and other equipment, and generated more than $1.4 million through scrap metal recovery and the resale of non-computer equipment.

At Nijmegen, the European Services and Supply Center has nearly eliminated the use of CFCs. The site has also significantly reduced paper use by re-using nearly half of all incoming packaging. Other programs include energy saving transportation and the reduction of disposable items such as office supplies and cafeteria utensils.

The San German manufacturing plant has established a goal of zero industrial wastewater by 1996. Results to date include a 50 percent reduction of sludge generation, a 50,000 gallon-per-day reduction of water use, and a drop in chemical usage. These efforts have saved Digital $590,000.

VAXft System Beats Out Competition

Digital's fault-tolerant VAXft Model 310 system won the second annual Product of the Year Award, Systems category, as voted by readers of *DATAMATION* magazine.

Over 200 products were nominated in eight categories by readers, vendors, and editors. The VAXft System Model 310 beat out IBM's Enterprise System 9000 Series and Stratus Computer's XA/R Model 20 fault-tolerant computers in the systems category.

ODA Unveils Development Toolkit

Digital is providing a major component of a toolkit to promote the electronic interchange of documents, developed by the Open Document Architecture (ODA) consortium. The toolkit is designed to speed the development of different computer applications among diverse computer systems throughout the world.

Digital's ODA-Level API will provide an Application Programming Interface (API) definition and the common services needed to support the creation and interpretation of Open Document Interchange Format (ODIF) data streams.

The Consortium's goal is to develop software with consistent published specifications that it will license to other companies. Applications programmers working on EDI (electronic data interchange) have been hampered in part by the lack of consensus on how data should be stored, accessed, and shared.

The ODA Consortium was established last year as a European Economic Interest Group, headquartered in Brussels, Belgium. Other members of the ODA Consortium include Groupe Bull, IBM, ICL PLC., Siemens Nixdorf Information Systems, and Unisys.

Taiwan Plant Boosts PC Manufacturing

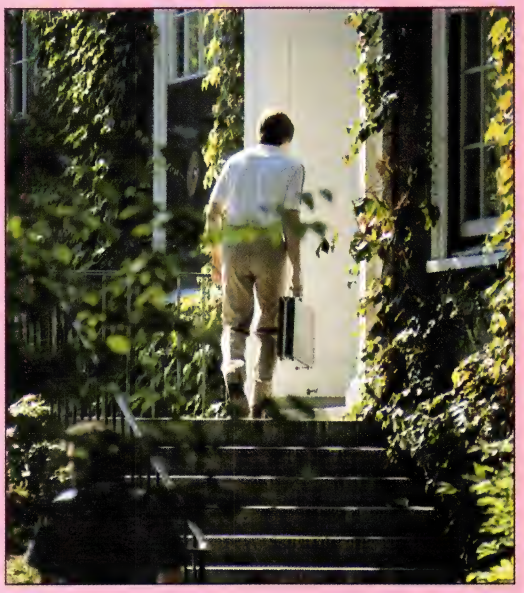
Digital will utilize its world-class manufacturing facility in Taiwan for PC design and manufacture. This move will strengthen relations with Intel Corp., Tandy Corp., and Ing. C. Olivetti SpA, who have been supplying Digital with various components for the manufacture of PCs.

Intel has been supplying chips for various models, while Olivetti has been jointly producing portables with Digital, mainly for sale in Europe. Tandy has been building PCs to Digital's specifications, and Digital has been adding value by including its own components in those units. The three vendors will continue to supply Digital with a variety of products for the Taiwan facility.

Making the Transition to Teaching

More than 100 former Digital employees have made the transition from engineering positions to full-time teaching as part of Digital's Engineers Into Education program.

Now in its third year of operation, the program encourages qualified technical employees to make a career change from engineering to education, teaching math,



science, computer science, or engineering at any level from elementary school to graduate school.

Following the 10-week trial period, interested participants return to school for two years to prepare themselves for a teaching career. Employees can attend college to become certified teachers, to update their teaching skills or subject knowledge, or to earn advanced degrees in science or mathematics.

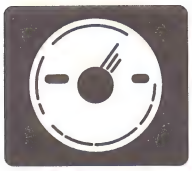
Digital Cited by HISPANIC Magazine

Digital is featured in the list of 100 companies selected by *HISPANIC* magazine for providing opportunities for Hispanics. The listing appeared in the magazine's January/February issue.

The magazine cited Digital's Hispanic Leadership Group (HLG), which coordinates local programs, strategies, and business opportunities for Hispanics on a regional basis. The HLG also arranges extensive Hispanic Heritage Month activities, a fundraising banquet for the National Hispanic Scholarship Fund, and other Hispanic outreach efforts.

To purchase or learn more about products featured in Product INSIGHT, *or to read back issues of the magazine, use the online Electronic Store. All you need is a VT100-compatible terminal and a 1200-, 2400-, or 9600-baud modem. Then just dial 1-800-234-1998 from any location within the United States. For more information about Digital products and services, please call your local Digital representative or the Corporate Customer Assistance line, 1-800-DEC-INFO (1-800-332-4636).*

HARDWARE



SOFTWARE

Product	Description
Entry-level DEC Network Integration Server (DECNIS) 500 packages	Include the DECNIS 500-XP package, which supplies multi-protocol routing and X.25 capabilities, and the DEC WANcontroller 622 X.21 packages.
DECserver 90TL server	Operates standalone or in a DEChub 90 Ethernet backplane; manageable remotely using SNMP, TSM, MOP, and Telnet Remote Console. Supports TCP/IP.
MUXserver 320 and 380 remote terminal servers	Enable remote users at one site to access services at a local Ethernet site over leased phone lines.
32-Mbyte memory option for VAX 4000 and MicroVAX 3000 systems	Features forward and backward compatibility. Conserves Q-bus slots for more options.
applicationDEC 400xP system	Provides three models of a floor-mounted uniprocessor tower based on Intel's i486 processor, with an exchangeable daughter-card for easy upgrades, memory expansion up to 192 Mbytes, and high-speed EISA peripheral cards.
PCXAR-BA 80-Mbyte IDE hard disk drive for DECpc 433W systems	Increases disk capacity to 85 Mbytes (formatted) in 512-byte blocks on 2.5-inch rigid disk media.
MD30C color scanner	Offers flatbed color, grayscale, and bitonal scanning capabilities for desktop electronic publishing with a built-in SCSI-II interface.
DECfactory solutions	Include the BASEstar, DECmessageQ, DEComni, and DECosap offerings. Integrate Digital products with third-party applications and services.
DECrti V3.0	Supports general realtime applications. Improves display, ease-of-use, NAS integration, performance, productivity, and packaging.
DEC RdbAccess for VAX RMS on VMS V2.0	Provides direct SQL-based read/write access to RMS files and a read-only VAX SQL access gateway to IBM VSAM and some non-VSAM date sets. Improves performance.
DEC RALLY V4.0	Includes a DECwindows Motif development user interface, support for multivendor client/server communications.
DECmessageQ V2.0	Provides message servers for VAX ULTRIX and RISC ULTRIX, Hewlett-Packard HP-UX, and Motorola SYSTEM V/88 systems through TCP/IP network communications. Expands integration to Apple Macintosh clients, enhancing MS-DOS clients with Microsoft Windows and Borland C++ support.
DECwindows Tools Package for Motif on the Sun SPARCstation V1.0	Includes DEC VUIT V2.0, LinkWorks Developer's Tools V1.0, and DECwindows Graphical Interface Tools V1.0, all supporting the Sun SPARCstations 1, 1+, 2, and Interprocess Communication (IPC) and using the Highland Software FLEXlm license manager.

	Product	Description
SOFTWARE	ALL-IN-1 Performance Reports for VMS software	Analyzes DECtrace performance data to provide detailed ALL-IN-1 usage and performance reports and improve performance. Allows clusterwide monitoring of ALL-IN-1 performance.
	SQL Multimedia for Rdb/VMS V1.0	Furnishes both development and runtime multimedia capabilities for VAX Rdb/VMS database applications.
	Image Print-PLUS software for the turbo PrintServer 20 printer	Prints bitonal images on turbo PrintServer 20 printers at up to 20 pages per minute. Produces all file types supported by the PrintServer 20 printer, including PostScript and ANSI.
	DECphoto Imaging Solution V1.0	Captures, annotates, and electronically distributes color or grayscale video images from any standard video source on VAXstation workstations running the VMS operating system.
	DECimage Scan Software V3.0	Adds a DECwindows Motif application interface and image enhancement functions for VAX VMS and RISC ULTRIX systems.
	International lexicons	Offers word lists that verify and correct spelling within multilingual and specialized business documents.
	DECexpress products	DECexpress Starter V1.0 provides programming assistance with its EXPRESS information modeling language syntax parser, EXPRESS language sensitive editor (LSE) template, and EXPRESS language reference manual and associated user guide. The DECexpress Graphical Editor V1.0 DECwindows Motif-based tool creates and modifies EXPRESS information models.
	SPXg and SPXgt 3-D graphics for VAXstation 4000 Model 60 systems	Offers high-resolution 3-D graphics for CAD/CAM, GIS/mapping, true-color imaging, and molecular modeling. Conforms to GKS, PHIGS, and PEX standards.
SERVICES	DEC VTX consulting services	Provide consulting and implementation support for over 60 internal VTX servers and updates for 16 VTX infobases.
	New services for DECathena Start-up Package	Includes the Comprehensive Assessment Service, for companies planning to use the DECathena product as a management tool for workstations, and the Application Migration Service, for sites already using the DECathena product that want to continue to use their current applications.
	Enhancements to Education Software Library (ESL) program for educational institutions	Provide centralized technical support for the more than 350 software products in the Campuswide Software License Grant (CSLG) program for educational institutions.
EDUCATION	*VMS for Alpha Platforms Internals and Data Structures, Preliminary Edition, Volume 1* by Ruth E. Goldenberg and Saro Saravanan (EY-L466E-P1)	Describes VMS operating systems support for the 64-bit Alpha RISC architecture. Addresses I/O architecture, interrupts and exceptions, hardware interrupts and machine checks, software interrupts, system service dispatching, ASTs, synchronization techniques, overview of the I/O subsystem, I/O system services, and I/O processing and naming conventions.
	Software Implementation Techniques: VMS, UNIX, OS/2, MS-DOS by Donald E. Merusi (EY-J822E-DP)	Compares the capabilities of the four different operating systems for developers working with one operating system but planning to move to another in a multivendor computing environment.

EDUCATION

Product	Description
Digital at Work: Snapshots from the First Thirty-five Years by Jamie Parker Pearson (EY-J826E-DP)	Offers insight into Digital's culture and development. Examines the development and introduction of the PDP-1, PDP-11, and VAX computers and Digital's networking products.

Third-party Agreements

Complementary Solutions Organizations (CSOs) extend Digital's portfolio of solutions. Leading third-party application suppliers become allied with Digital through a variety of agreements, programs, and relationships: the Cooperative Marketing Program (CMP), joint marketing and product development agreements, Complementary Software House (CSH) relationships, Digital Distributed Software (DDS) and Digital Service Alliance (DSA) agreements, the Independent Software Vendors (ISV) program, Master Integrated Distribution and Subcontracting (MIDAS) agreements, System Integration Reseller (SIR), Consultant, and Reseller relationships, and Engineering, Distribution, and Strategic Cooperative agreements. Together, Digital and its CSOs bring a wide range of integrated computing solutions to the marketplace.

Company	Application	Agreement Type
A. Maira and Company Sudbury, Massachusetts	Support in redesigning sales and marketing operations and processes, adding products or product lines, adding new distribution channels, and entering international markets.	Consultant
Advanced Technology Center Laguna Hills, California	Porting and marketing of the Programmer's Hierarchical Interactive Graphics System to multiple platforms.	Engineering and Distribution Agreement
Broadway & Seymour, Inc. Charlotte, North Carolina	Systems integrator and software provider for the banking, manufacturing, and health care industries.	SIR
Cyborg Systems Chicago, Illinois	Integrated human resource and payroll solution running on RISC ULTRIX and VAX VMS systems.	CMP
DataMedia Corporation Nashua, New Hampshire	SECUREcard 100 with access control, file encryption, and unattended PC protection for notebook, laptop, and low-end single user PCs.	ISV
Halcyon Software Campbell, California	DoDOT 4.0 for vector and bitmap conversions. Compatible with PATHWORKS Links product.	ISV
Informix Software, Inc. Menlo Park, California	Application development tools, relational database engines, open systems connectivity tools, and personal productivity products for SCO UNIX and ULTRIX systems.	CSH
Kuck and Associates Champaign, Illinois	Automatic optimization technology to improve the performance of FORTRAN and C applications on VAX VMS and RISC ULTRIX platforms.	CSO
MasPar Computer Corporation Sunnyvale, California	RADIOSS software for the DECmpp 12000 series and MasPar MP-1 massively parallel computers.	CSO
NPRI Alexandria, Virginia	Sales activity management software for long-term team sales running on VMS systems and DOS PCs.	Reseller
Omnitech Chicago, Illinois	Support for developing marketing strategies, improving market and sales operations, and automating these functions.	Consultant
Proteon Westboro, Massachusetts	Proteon Token Ring products for PC networking interface cards, bridging routers, and management.	Reseller
RAM Mobile Data USA New York, New York	A packet data radio network operator for mobile and portable computer users.	Strategic Cooperative Agreement

Fernando Colon-Osorio

In Quest of Computer Systems without Fault

In the March 1990 issue of *Product Insight,* Fernando Colon-Osorio said that businesses in the '90s will demand fault-tolerant systems that ensure high availability for mission-critical applications. Today, he reaffirms that belief and predicts that

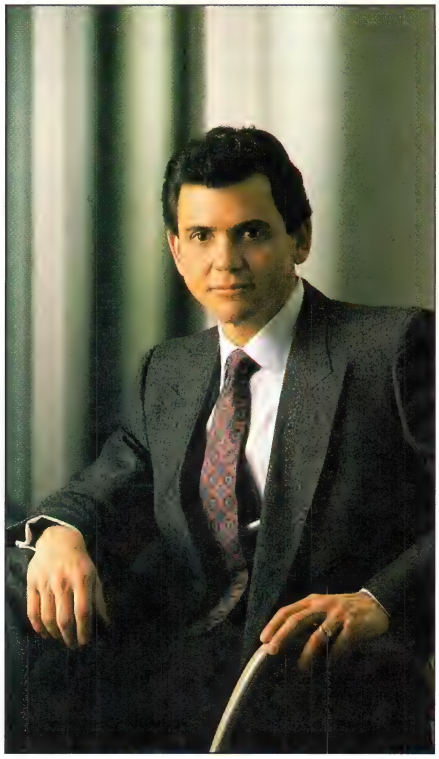


Photo: Sylvia Stagg-Giuliano

The most satisfying thing for any engineer is to see a machine you have worked on come alive. When it starts doing what you designed it to do, it's like hearing your child start talking to you.

Fernando Colon-Osorio, engineer, manager, humanist

availability will become the key differentiator. The price/performance metric used to evaluate systems in the '80s will be replaced by a price/performance/availability metric.

"Users today understand that when a computer is unavailable to perform, its cost becomes infinite," he explained. The challenge for Digital in the 1990s, he believes, is to move beyond fault-tolerant systems to "systems without fault." That is, systems that can handle any fault – environmental, software, or hardware – and keep on performing without apparent interruption.

Colon-Osorio drives this vision both as a unit manager and as a corporate strategist. As a manager, he heads the fault-tolerant systems unit of the VMS Systems and Servers organization. As a corporate consulting engineer, Colon-Osorio helps direct Digital's product and technology strategy.

A Change of Plans Leads to Digital

The greatest disappointment in his life brought Colon-Osorio to Digital 16 years ago. His ambition was to teach electrical engineering at the University of Puerto Rico, where he had worked at many part-time jobs to finish a five-year program in four years. So, at the age of 21, he left Puerto Rico for the first time to pursue graduate work at the University of Massachusetts (UMass) at Amherst.

While completing his master's and doctoral degrees in electrical and computer engineering, Colon-Osorio worked on projects funded by Digital, among them the development of a virtual operating system and memory management for PDP-11 systems. He also began to write a book with Bob Glorioso.

Now a vice president, Glorioso was then manager of Digital's Corporate Research Group. Published by Digital Press in 1980, *"Engineering Intelligent Systems"* expands on ideas Colon-Osorio had developed in his dissertation on learning theory.

Colon-Osorio still intended to teach after graduate school, but when he finished his doctorate, the University of Puerto Rico had no jobs to offer. His greatest disappointment became Digital's good fortune. He was hired in 1976 and put in charge of a project to design a floating-point processor for the PDP-11/60 computer.

Becoming Accustomed to Life at Digital

Colon-Osorio recalled his first Digital project as an exhilarating experience.

"We worked 18 hours a day for nine months," he said. "Never have I done so much, so quickly, so happily. The spirit of the company overwhelmed me. I felt there was nothing Digital couldn't do, nothing I couldn't do if I put all my energy into it. It gave me a great sense of empowerment."

Equally vivid is the memory of sharing his first office with Larry Condon and Joe Mangiafico. "It was a stroke of genius to put a kid just out of school with two men who were already engineers," he said. "That first week, I didn't know what they were talking about. It would have taken me a very long time to learn, by myself, what they taught me in a very short time about engineering and the company."

Larry Condon, now responsible for total quality management in the Data Centers Systems and Services organization, recalled, "Fernando was clearly knowledgeable, eager to learn, and very outgoing. People responded readily to his high energy, his wanting to learn everything and do it right. It was obvious to a lot of people that he would advance in the company."

A Passion for Engineering

Four years ago, Colon-Osorio was named a corporate consulting engineer, a title that signifies Digital's recognition of outstanding technical achievement. He has been involved in many major projects, including design of the VAX 8600 series. He continues to write, publishing articles on learning theory as well as technology. From 1978 through 1982, he was an associate editor of the *IEEE Transactions in Computing.* He also writes poetry. In fact, he has published a book of poetry and short stories in Puerto Rico.

"Fernando is indeed a unique individual," commented Bill Demmer, VMS Systems and Servers, vice president.

Fernando Colon-Osorio spent many hours in scenic Puerto Rico dreaming of the day he would teach electrical engineering at the commonwealth's university. His education on the mainland United States led him to pursue a career at Digital, but he still makes time to vacation in his native Puerto Rico...and to dream.

"His breadth of interest and passion for living and working make him visible wherever he goes. These are the sources of his many strengths and can also stimulate controversy, which in turn stimulates Fernando to even higher levels of energy and commitment to his work."

For Colon-Osorio, engineering is a passion and he is eloquent on the subject. "The most satisfying thing for any engineer is to see a machine you have worked on come alive. When it starts doing what you designed it to do, it's like hearing your child start talking to you."

Driving toward Systems without Fault

Engineering a system without fault requires attention to every factor that can affect availability, including the user.

"It's not enough to give customers the most robust system possible and then leave them to write code that can introduce errors," said Colon-Osorio. "We have to help our customers develop applications without faults or supply tools that can make their applications fault tolerant. To become the world's premier supplier, we must treat our customers' problems as our own."

Glorioso observed that Colon-Osorio has always gone out of his way to help customers. He recalled "a customer who had a mysterious problem with a complex cluster. No one could isolate the cause until Fernando attacked the problem by bringing in a team of specialists who finally found two separate problems."

Building a Creative Environment

Colon-Osorio finds that engineering and managing integrate nicely for him. He considers two things essential to good management. The first is to know exactly what is going on in every area of a project at any given moment. The second is to create an environment that encourages creativity and empowers people to achieve.

Difficult as that is in a time of transition, Colon-Osorio believes managers can establish in their own groups cultural values that will renew the company's spirit. Acting on that belief, he tries to know all the people who report to him.

Two or three times a week, 15 people join him for an early breakfast. When these breakfasts began, he was shocked to realize how few people knew one another. Now, he said, they do most of the talking, discussing and solving common problems.

Ann Katan, engineering manager for the Fault-tolerant Systems unit, observed, "Fernando is a charismatic personality and he is very good at making people feel that they are valued. His breakfast meetings are a good example. It is empowering for people to see that the head of the organization is really interested in hearing their concerns and ideas. It makes them realize just how important their jobs are to the company."

2000 and Beyond

Colon-Osorio believes that Digital can become the world's leading supplier of systems without fault by the year 2000. Superior performance plus availability will differentiate Digital's products from those of every competitor.

He also expects to see the emergence of an information utility as ubiquitous and reliable as the telephone is today. Subscribers will access repository services through notebook computers from anywhere in the world. "The technology exists today and the demand exists," he said. "It will happen."

As for himself, Colon-Osorio has found yet another compelling goal to pursue. He has become acquainted with the tragedy of autism through the child of a friend. Colon-Osorio intends one day to resume the work on learning theory that he began in his doctoral dissertation and join in the search for a solution. With his combination of technical ingenuity and sensitivity to human needs, he may well succeed.

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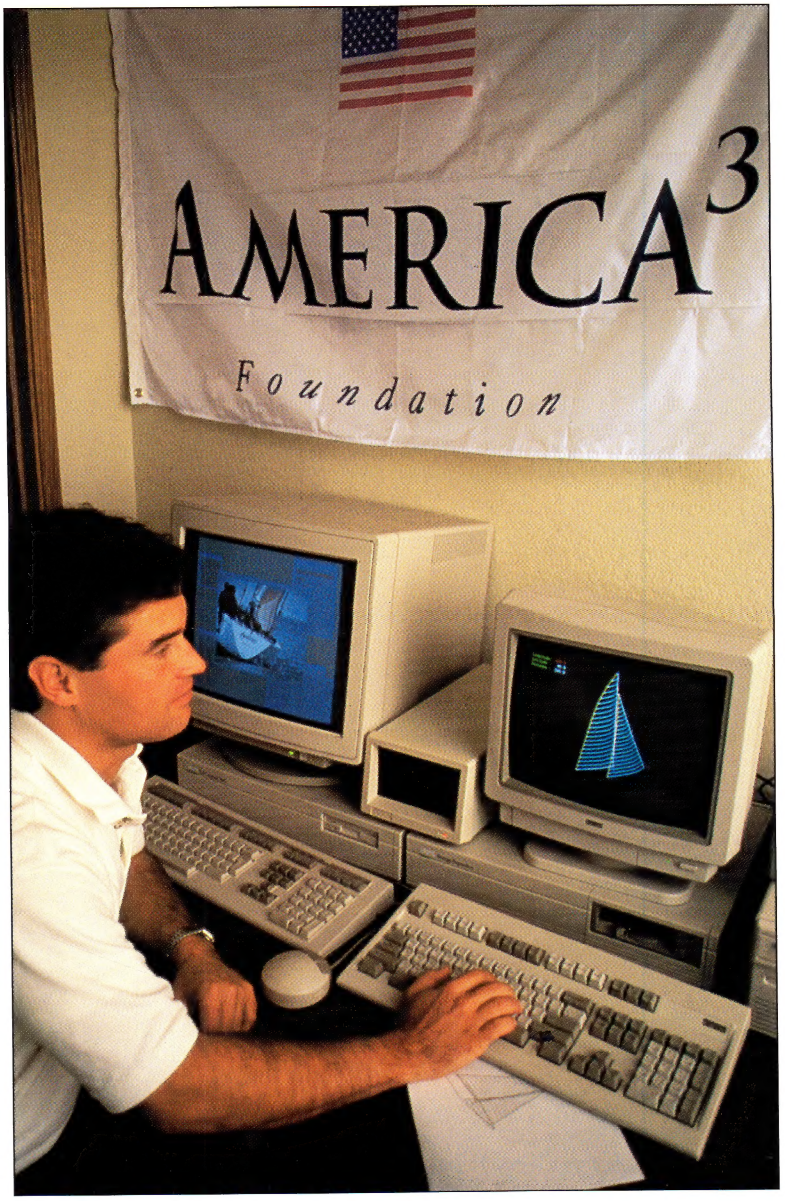

The America³ Foundation racing team, one of two United States syndicates involved in the America's Cup competition, took to the seas with the help of advanced computing technology. Researchers used a range of Digital computers, including PCs, workstations, and a VAX 9000 system, for design engineering, testing, and analysis, as well as performance analyses of boats and sails. Navigators of America³ boats employ onboard computers with speech-recognition systems for race management. Pictured here is Jack Kleene, a sail analyst for the America³ Foundation, analyzing sail shape and performance.

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